THE

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THE

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1900

Edition.

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SUPPLY STATION ACCIDENTS.

IN two recent issues we had occasion to comment upon the Blackheath fatality. We may perhaps be allowed to again return to this, as there is another phase of the question beyond that already dealt with.

In any case the report that an accident has occurred at Cheltenham, the account of a death by shock behind the switchboard of the Newport Corporation works, and the inquest upon the assistant who was killed at the Manchester Square station of the Metropolitan Company, punctuate and emphasise anything that may be said.

As every engineer who is fit to hold a responsible position in a station knows all about the Dangerous Trades Committee of the Home Office, it is hardly necessary to go into detail and rake up ancient history. At the same time, while Prof. Perry is urging upon engineers the importance of mathematics as affecting the professional side of their work, we should like to call their very serious attention to the quasi-legal side which is closely concerned with the financial and commercial aspect of their vocation, and to remind them that while Acts of Parliament and Blue-books are not expensive to buy, it may prove rather expensive and damaging not to have bought them and read what is contained therein. Thus in the inquest on the body of Arthur Robinson, aged 18, who was killed at the Blackheath Works, it appears in the evidence that the resident engineer, after the inquest on the body of a previous victim, received a copy of certain regulations which had been drawn up by the Dangerous Trades Committee of the Home Office, but admitted that he had not read them all!

As we said a fortnight ago, men of little education are only too prone to get careless and foolhardy, to ignore or even scoff at rigid instructions issued with the sole intent of ensuring their safety and guarding against such accidents, but as every engineer knows this it is obviously the duty of responsible persons to insist upon the due observance of recognised safeguards. Mixing high and low tension cables caused a fatal accident at Southampton; allowing a nail to be driven into a casing containing a high tension conductor had the same result at Bristol.

The Home Office suggestions boiled down amount to something like the following:—

(*a*) Never allow any work to be done on, about, or behind a high tension switchboard by a workman of any grade save under the supervision, continuously exercised, of a technically-qualified and responsible officer.

(*b*) Guard all live parts from accidental contact and remove all earthed metal work out of reach or cover it up.

(*c*) Cover the floor in front, behind, and about all high tension gear with good rubber matting of reasonable thickness, put in insulating platforms on oil insulators where necessary, and insist upon all spanners, knives, screw-drivers, and other tools having insulating ebonite or rubber moulded sheaths over the handles.

(*d*) Provide rubber gloves and require them to be worn wherever possible (and do not expect three pairs to last three years, as in one case we once heard of).

Our contention is that these safeguards are quite reasonable, and if provided and efficiently maintained, switchboard accidents would be reduced to a mere fraction of what has been the rule in the last ten years. Of course, even trained men will sometimes forget themselves, as when a shift engineer attempts to pick up the end of a live cable (which he himself has connected up) by the copper conductor, and as a result practically proves the value of rubber mats, while learning a lesson he will not forget in a hurry; but *as* accidents *will* happen in the best managed stations, proper tools and matting are required to rob them of the greatest danger, and—as we have forcibly urged before—the staff should all be *practically* acquainted with the Sylvester method of artificial respiration.

At Blackheath, the carpenter's boy lost his life through his own foolhardiness and ignorance, while the defect was lack of supervision and non-appreciation of potential danger. At Newport, a Mr. T. W. Griffiths was engaged upon tightening up a nut or terminal at the back of the switchboard, when he apparently slipped, and his knee came into contact with a terminal of one polarity, while his hand or spanner touched live metal on the other pole or earth. As Mr. Griffiths was trained at the University College, Bangor, he was a skilled man; he held a responsible position, and must have known full well the danger he ran in working in proximity to charged metal-work. Here is a case where gloves ought to have been worn, and had the deceased been so equipped, he probably would have escaped. The Home Office desires to make the chief engineer of a works responsible for the actual use of gloves. While, as we once said, this is unreasonable, we do think that educated men should take obvious precautions, although we are well aware from extended experience how very disagreeable it is to work in a cramped position for any length of time with hands encased in rubber gloves.

We condole with Mr. Copland, the resident engineer of the Newport works, on this sad fatality, but would impress upon all those who, with Prof. Perry, claim membership of a "profession," the necessity for surrounding the essentially dangerous work in station or on mains, for electric lighting, traction, or power supply, with all the safeguards which forethought, skill, and experience can suggest, as it must be the "officers who want educating most."

The accident at Cheltenham occurred in a sub-station, and it is not yet clear whether the attendant who suffered was the victim of a severe shock or not. He was engaged in connecting up some transformers for testing purposes and apparently fell upon a live transformer, but this was or had been covered with a rubber mat. Underground sub-stations are places where a workman is in great danger owing to the confined space, and we consider supervision the only safeguard. A skilled engineer would insist upon the use of insulating mats or platforms, and would arrange for the work to be carried on so that should an accidental contact be made, the workman could not even then close the high tension circuit through himself or get between a live conductor and earth.

The Metropolitan fatality is only too much like that at Blackheath. An assistant presumably came into contact with a switch thinking it "dead," or in carrying out his work caught hold of a connection. He was connecting up cables to the board and "would not wear gloves" although he caught hold of the metal-work of a switch with both hands. There is a saddening monotony about the accounts of such accidents, and the means of preventing their recurrence seem to be embodied in the paragraphs (*a*), (*b*), (*c*) and (*d*) before mentioned. Managers and chief engineers may expect to be made personally responsible for the employment of protective devices, should the public be horrified by a repetition of such fatalities at short intervals. We know all the difficulties, but in the twentieth century public opinion will require steps to be taken to efficiently protect employés against sudden death from shock, and it would be better that this should be done willingly and at once than by the force of legislative enactments.

A Castle Installation.

In the description which we give this week of the very interesting installation at Ardross Castle, we have an illustration of what may be done with a small water-power. That a tiny stream of less than two miles long should be capable of supplying so extensive an installation as that at Ardross is remarkable, and the possibility of a failure in the supply during either dry or frosty weather would have appeared at least likely. The success of the installation confirms the consulting engineer's opinion of the value of the little stream. We question, however, whether so small a source of water would be found to be adequate in the majority of cases, and the development of such a power is eminently a question for an experienced expert to decide. The Highlands of Scotland abound with small water powers, similar to that described, but unfortunately the opportunities of developing them are rare, on account of their remoteness from any residence or village where the electricity might be utilised. Where, however, the power is conveniently handy as in the installation described, it may prove of very substantial value, and a source of considerable profit to the owner, apart from all considerations of luxury and convenience.

Workmen's Compensation.

The knotty questions which are still brought before the Court of Appeal in connection with the Act of 1897, serve to show that its meaning is not yet properly understood by those who are affected by its provisions. Among those which have recently been heard by the Master of the Rolls and his colleagues, that of Ferguson *v.* Green is the most extraordinary. As our readers are doubtless well aware, the Act only applies to buildings over 30 feet high or upon which a "scaffolding" is used in connection with the repair or demolition thereof. What then is a scaffolding? In the case of Ferguson *v.* Green, the applicant for compensation was a plasterer who, in order to facilitate his work in the interior of a house, had constructed a platform by means of two trestles across which he had placed some loose boards. The arbitrator before whom the case came in the first instance, decided that this was not a scaffolding, and that, therefore, the workman was not entitled to succeed. The Court of Appeal said this was right. But when we look at a case of Maude *v.* Brook, which was heard early this year, we find that upon a precisely similar state of facts, the arbitrator had held that such an erection *was* a scaffolding, upon which he awarded compensation—and was upheld by the Court of Appeal. We have before now adverted to the anomalies which have arisen in the practical application of this Act, but this one appears to surpass all others which have come to our notice.

PRACTICAL METHODS OF OVERCOMING THE VIBRATIONS CAUSED BY MOTORS.

By SHERARD COWPER-COLES.

About two years ago the writer's attention was drawn to the question of finding some means for running motors,

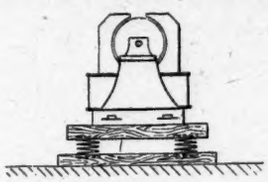


Fig. 1.

dynamos and motor transformers in upper floors of buildings without causing any noise and vibration, as several actions had been brought against tenants of flats and offices for causing noise by the running of motors.

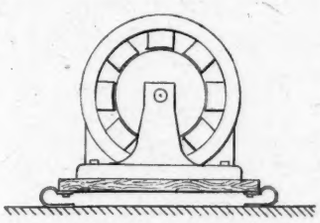


Fig. 2.

A number of experiments were tried, using felt, rubber buffers and washers, cork, and felt interleaved with lead. Placing the motor on a thick bed of sawdust or coffee husks, or some similar soft and comparatively elastic material was also

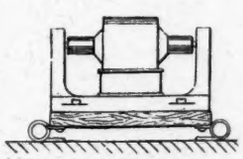


Fig. 3.

experimented with. None of these methods were found to entirely remove the nuisance, but only to reduce it.

Placing the motor on springs, as shown in fig. 1, was then tried, and this was found to be entirely satisfactory. The machine was not bolted to the floor, but the wood frame on which it was placed was merely allowed to rest on the

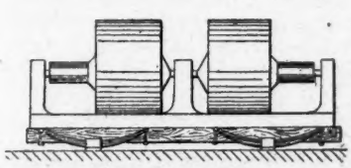


Fig. 4.

springs, suitable recesses being cut to prevent lateral movement. The experiments were first of all made on a 1½-H.P. motor, run at a speed of 1,450 revolutions per minute, used for driving light machinery in a room over some residential flats and offices, on a badly constructed wooden floor. This machine was mounted on springs as shown in fig. 1, and a heavy weight was placed on the motor, so as to counteract the pull of the belt. The motor has been running daily, and not a single complaint has been received since this system was adopted. Heavier motors have been mounted as shown in figs. 2, 3, 4 and 5, and small motor transformers are suspended on springs, as shown in fig. 6.

Since writing the above, the author's attention has been called to a paper read at the Engineering Conference of the

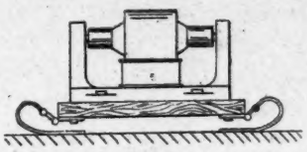


Fig. 5.

Institution of Civil Engineers held in May, 1897, when Mr. James Swinburne read a short paper entitled "Should Generating Plant be mounted on Springs?" Reference is made to a small dynamotor which was mounted on springs and placed on the top floor of a house; no particulars are given as to the method adopted, but the cure was an effectual one.

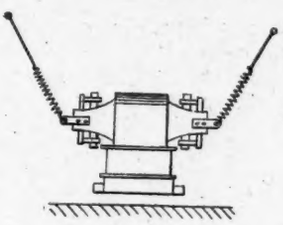


Fig. 6.

Mr. Swinburne mooted the idea of mounting dynamos and motors on springs in an article which appeared in *Industries* in 1892. Mr. W. Beaumont has done some good work in connection with this subject, and has introduced his "vibromotor" principle, which is simple. "If a gear wants to wobble, let it wobble."

THE POSSIBILITIES OF ELECTRICAL SMOKE DEPOSITION.

By J. WRIGHT.

A recent "leader" on smoke abatement, in a previous issue of this journal, suggests a back reference to some of the earlier experiments in the direction indicated by the title of this paper—a subject which has been hardly, if at all, touched upon during the intervening years.

In a city like London, where smoke is, to a great extent, responsible for the thick, murky fogs which so often come upon us during the colder seasons of the year, one would have thought that ere this some cheap and reliable method, at least possible with the larger smoke-producing establishments, would have been perfected and universally adopted. The improvement of smoke-consuming furnaces has, perchance, influenced its introduction; nevertheless, the small percentage of these furnaces which has been adopted, points to the necessity for a more popular process which will tend at least to minimise the enormous quantity of smoke which daily pollutes the atmosphere in our great cities and towns.

In a paper read before the Royal Institution of Great Britain on Friday, May 28th, 1886, Prof. Lodge discussed this subject theoretically and experimentally. The paper was founded on Dr. Tyndall's well-known experiment, which consists in holding a heated body in the path of a sunbeam or ray of light from some other source, when a dark, dust-free space is produced in its neighbourhood. The popular theory with regard to this experiment is, that the dust particles are consumed in the immediate neighbourhood of the heated object, and that the space surrounding it is, in consequence, rendered invisible owing to their absence. The incorrectness of this theory was proved in 1881 by Lord Rayleigh, who found that, on reversing the experiment by

D

holding a cold body over the beam of light, a similar result was obtained in the shape of a descending dark plane in the neighbourhood of the object.

Lord Rayleigh's suggestion was that the dark space might be due to the curvature of stream lines produced by the moisture in the air and centrifugal force. That this theory was also an incorrect one was proved in turn by Prof. Lodge, who produced the dark coat on the concave surface of a half cylinder of red-hot copper. Here, according to Lord Rayleigh's stream curvature theory, the dust ought to be thrown towards the concave surface of the half cylinder, the curvature of that surface being negative.

The theory arrived at by Prof. Lodge as the result of his investigations was, that the dust particles were retained out of contact with the surface of the warm body by a species of molecular bombardment of their own surfaces.

The facts arrived at by experiment were as follows:—

1. The dark plane becomes visible over a cylindrical thermometer bulb indicating a temperature only half a degree warmer than air.

2. The dark coat becomes just visible round a body 1° hotter than air; at 2° it is distinct, and at 5° it is fairly thick.

3. The coat enlarges with diminished pressure, and narrows when the pressure is increased.

4. In hydrogen the coat is thicker, and in carbonic acid thinner than in air.

5. If volatile smoke, like volatilised camphor, is used, the coats become thicker, though less sharply defined.

6. Round a rod of camphor in ordinary smoke, the dust-free coat is extra thick, owing to the extra bombardment of evaporation.

7. Round cold bodies the coat is practically absent, especially on the top of the body, and if the cold is too great, no descending dark plane is formed, only a bright one.

8. Liquids containing solid powder in suspension (*e.g.*, dried ferric oxide in water) form a very narrow dark plane over a moderately warm cylinder; but the thickness of the plane is so slight, that it is difficult to observe, and it gets thinner with increase of temperature, instead of thicker, as in the case of gases; hence the experimental rod in a liquid must be only gently warmed.

It is a well-known fact that cold bodies in a warmer, dusty atmosphere, have the dust bombarded or deposited on them. Instances of this may be seen on the ceiling of a room over a hot water pipe, gas jet, or even an incandescent electric lamp.

Another theory advanced by Prof. Lodge, and one which ultimately led to the discovery of the smoke-dispersing qualities of electrified air, was that the latter became electrified in passing over the surface of a solid body, and in some manner expelled the solid particles contained in it. In order to test this theory, a suspended body was electrified in an atmosphere artificially charged with smoke. Whilst the potential was low, about 100 volts, little effect was produced beyond the widening and narrowing of the dark space by positive and negative charges of electricity respectively. On raising the potential, however, to some thousands of volts by means of an influence machine, to such a point that a brush discharge was possible, the dark space was suddenly and rapidly widened, and the smoke being diffused, was deposited on the sides and bottom of the containing vessel.

The best effects were produced when the conductor took the form of a point, and the smoke was deposited like a map along the direction of the lines of force. The explanation of the phenomenon is as follows:—

The smoke particles become electrified by induction and are attracted to one another, and also to the opposite pole, in a similar manner to iron filings in the vicinity of a magnet. A similar effect is obtained with vapour or damp smoke, which is condensed in the form of mist or fine rain.

There are one or two difficulties to be overcome in the application of this process to practice. One is the natural draught in an active chimney or flue. This difficulty could, however, doubtless be overcome by experimental practice, in fact, it has been effected, though in a somewhat inefficient manner, by a system of pointed conductors fitted at the top of the chimney, and surmounted at a short distance above by a cap or dome of electrified wire gauze or netting. This method has been found to assist the draught, and also to condense some, though not all, of the smoke.

Another plan suggested by Prof. Lodge is to suspend a sheet, or sheets, of wire netting, provided with numerous points, or barbs, longitudinally along a flue, or chimney, and to oppose an opposite conductor on the walls of the chamber in the shape of a series of points.

Another somewhat serious difficulty lies in the matter of insulation between the two poles, owing to the deposition on the conductors of soot and smoke particles. I would suggest to obviate this a protective insulating sleeve extending over, though not actually touching, that portion of the conductor nearest its point of support for some few inches from the latter. This would at least protect the actual fixture from deposit, and, as to the extremities of the conductors, the natural draught would probably assist in keeping them clear, at least for a certain period, of excessive deposition.

A development of such a process as that herein discussed for the minimising of smoke nuisances is bound to come sooner or later, and would, no doubt, be cordially welcomed by the victims of a pea-soup fog as well as those individuals and companies who are at present enjoying the luxury of a periodical fine at the instigation of certain smoke abatement committees.

THE IMPERIAL PHYSICO-TECHNICAL INSTITUTION IN CHARLOTTENBURG.*

By HENRY S. CARHART.

Through the courtesy of Prof. Kohlrausch, President of the Reichsanstalt, and the Curatorium or governing body of the Institution, the writer was accorded the privilege of working in the Physikalisch-Technische Reichsanstalt as a scientific guest during the last few months of 1899.

The Reichsanstalt is situated in Charlottenburg, a suburb of Berlin just beyond the renowned Thiergarten. The buildings occupy an entire square, the larger part of which, valued at 500,000 marks, was the gift of Dr. Werner Siemens. In making this gift, which was offered in land or money at the option of the Government, Dr. Siemens declared that he had in mind only the object of serving his fatherland and of demonstrating his love for science, to which he avowed himself entirely indebted for his rise in life. The gift was made as a stimulus to the Government to establish an institution for physical research.

The general plan of the Reichsanstalt was adopted in 1887, and an appropriation of 868,254 marks was made and spread over the budget for three years. The main building for the first or scientific division was completed in 1893. The second, or technical division, was housed in a portion of the Technical High School till the buildings for this division were completed in 1897. All departments of activity of the Reichsanstalt are now accommodated on the square facing on March Strasse in Charlottenburg. They include the division for pure scientific research, mechanical measurements of precision, electrical measurements and instruments, the measurement of large direct and alternating currents and electromotive forces, the optical department, the department of thermometry, the department of pyrometry, and the department of chemistry. To these, as auxiliaries, should be added the power plant and the workshop.

The two divisions into which the Reichsanstalt is divided correspond to the two paramount objects which the founders had in view, viz., research in pure science, and the cultivation of precision in the technical applications of science. All the applications of science rest on the foundation of pure scientific discovery. The creation of new and improved methods and instruments for physical measurements requires the most exhaustive and painstaking investigations as a preliminary to a steady and confident advance. The practical value of research in pure science is no longer in question. The wise founders of the Reichsanstalt made no mistake in coupling an institution for the promotion of technical pre-

* Abstract of a paper presented at the 146th meeting of the American Institute of Electrical Engineers, New York, September 26th, 1900. President Hering in the chair.

cision with one for the prosecution of research in physical science.

The chief officer of the Reichsanstalt is the President, and the most distinguished physicist of the realm is sought for this position. Helmholtz was taken from the University in Berlin to become the first incumbent of the office; after his death, in 1894, his successor as professor of physics in the University, Prof. F. Kohlrausch, became his successor as President of the Reichsanstalt.

The President, who is at the same time director of the first division, is held responsible for the successful work of the Reichsanstalt. All other officials are, therefore, subordinate to him.

The specific duties of the President may be briefly enumerated. He must lay before the Curatorium, at its annual meeting, the following:—

1. A report on the work executed in both divisions.
2. The plan of work for the undertakings to be carried out during the ensuing year.
3. Propositions relative to the money to be expended for scientific and technical work; also for salaries and remunerations.
4. Propositions relative to the rank of permanent associates and assistants; also relative to the bestowal of places to work in the Reichsanstalt as scientific guests.

He takes a vote on the propositions in 3 and 4, and reports the conclusions of the Curatorium to the Government for approval. It is also the duty of the President to sign vouchers for all payments, and he is held responsible for the proper expenditure of the money appropriated for the maintenance of the Institution.

The different functions of the two divisions composing the Institution are defined in rather broad terms. It is the duty of the first division to carry out physical investigations requiring more uninterrupted time on the part of the observer, and better accessories in the way of instruments and local appliances, than private individuals and laboratories of institutions for teaching as a rule can offer. These investigations shall be carried out partly by officers of the Anstalt, and partly, under their oversight, by scientific guests and voluntary workers. By scientific guests in general are meant the holders of scientific positions in the German Empire, who wish to prosecute scientific researches, the plan of which they have submitted, and for which they have not at home the necessary appliances. They must be recommended by the State in which they reside, and must be accepted by the Curatorium.

Young men may be accepted as voluntary workers who have proved their ability by scientific publications. They will undertake researches which have been determined upon by the Curatorium or the Director; or they may investigate subjects which they themselves suggest, and which appear to the Director to be practicable and worthy of execution. The scientific results obtained must be published only at the discretion of the authorities of the Institution, who reserve also the right to publish them in the researches of the Reichsanstalt. Provision is made that voluntary workers shall not use the Institution for private ends, nor to obtain patents.

The second division of the Reichsanstalt is placed under a Director, who is subject to the higher authority of the President. Such a Director was considered necessary, on account of the special work of this division, as well as because of the intimate relations into which it is brought with many persons engaged in industrial pursuits. He should therefore not only be a scientific man, but should, at the same time, have some technical knowledge of the applications of science. Under the Director are placed the permanent heads of the sub-divisions of the technical department, one having the oversight of thermometry, one of optics, two of electricity, and one of mechanical measurements of precision. Along with these, and of the same rank and compensation, is the director of the workshop. Under him, at present, are eight mechanics, and the shop is provided with the finest tools for the execution of the most exact work required by the Institution. The annual expenditures for 1889 were as follows:

1. Expenditures for salaries and labourers ...	206,604 M.
2. Miscellaneous articles, experimental work and care of buildings	127,000 „
Total	333,604 M.

The receipts for calibrating instruments, testing materials, verifying standards, and the like, now amount to about 40,000 M. annually. This sum should be deducted from the yearly expenditures, leaving a net sum of about 300,000 M.

In round numbers, the Reichsanstalt has cost $1,000,000, and the annual appropriation for its maintenance is $75,000.

A very pertinent inquiry is, what are the results of all this expenditure? Might not more good be accomplished by State aid to some existing technical school or university? In the memorials to which reference has already been made, Prof. von Helmholtz and Dr. Werner Siemens pointed out the advantages likely to accrue to Germany from the maintenance of an Imperial institution for research, which should at the same time assume the cognate function of fixing and certifying standards of mechanical and physical measurements.

Attention was drawn to the fact that other countries, notably England, had enjoyed great renown in science because of the brilliant researches and discoveries of some of her scientific men, who had the good fortune to be possessed of leisure and large private means, and the scientific spirit to devote them to investigations demanding both as a *sine qua non*. These conditions the memorialists declared were lacking in the fatherland. Her scholars, who had the enthusiasm and the capacity for exact scientific investigation, possessed neither the private fortune to devote to it, nor the uninterrupted time for the execution of the work. They were to be found among the men engaged in teaching, but their professional duties absorbed their time to such an extent that only an inadequate residue remained; and even that little was divided into fractions too small to admit of the sustained and continuous attention which any important investigation demands.

It was further pointed out that if the Government would supply the conditions favourable to scientific discovery, the men could be found whose work would reflect great credit on the State, while the interaction between pure science and its applications to art and manufactures would put Germany in the forefront of scientific renown and of the intelligent application of science to useful purposes.

It was further urged by Von Helmholtz that the brilliant investigations of Regnault and other French physicists many years ago should now be repeated with the superior methods and instrumental appliances available at the present time. These investigations drew the attention of the scientific world to France, and made it the focus of scientific interest. Her instrument makers, even up to the present, have reaped a rich reward in foreign orders for instruments made eminently desirable, and almost indispensable by these distinguished French investigators.

Other problems, too, needed solution, problems forced to the front by modern requirements and discoveries. The applications of electricity, for example, present new questions for science to answer, while the interests of the consumer at the same time call for some form of control by the State of the instruments employed in fulfilling contracts. The very units in which such measurements are made need to be authoritatively settled—a task demanding the highest manipulative skill in experiment, and the most refined appliances which experience can suggest and money purchase.

The German Government admitted the force of these considerations and made splendid provision, both for pure science and its technical applications, by founding the Imperial Institution at Charlottenburg. The results have already justified in a remarkable manner all the expenditure of labour and money. The renown in exact scientific measurements formerly possessed by France and England has now been largely transferred to Germany. Formerly scientific workers in the United States looked to England for exact standards, especially in the department of electricity. Now they go to Germany. So completely has the work of the Reichsanstalt justified the expectations of its founders, and so substantial are the products of this already famous Institution, that other European nations are following Germany's example. Great Britain has already made an initial appropriation for a national physical laboratory to be organised on a plan similar to that of her Teutonic neighbour. Mr. R. T. Glazebrook, who has long served as

Secretary of the Electrical Standards Committee of the British Association for the Advancement of Science, has been appointed Director, and has entered on his duties. The new Institution will absorb the old Kew Observatory, and other buildings will be added at once for the extension of the functions of this Observatory, so as to include the larger enterprise contemplated in the establishment of the new National Laboratory.

(*To be continued.*)

CURRENT SPECIFICATIONS.

XXXVII.—BRISTOL ELECTRIC CRANE.

SUMMARY.

Extent of Contract.—Supply and erection at Avonbank electricity works of one electrically-worked crane.
Working Load of Crane.—15 tons.
Approximate Span.—47 feet 9 inches.
Test Load.—One and a quarter times normal full load.
Total Vertical Lift.—45 feet.
Clearance from Centre of Rails to Engine Room Wall.—9 inches.
Clearance from Top of Running Rails and Lowest Portion of Roof.—9 feet 9 inches.
Speed of Longitudinal Travel.—50 feet per minute.
Speed of Transverse Motion.—20 feet per minute.
Hoisting, Slow Speed.—15 tons, 4 feet per minute.
Hoisting, Quick Speed.—3 tons, 18 feet per minute.
System of Working.—One motor of Siemens or other approved make, semi-enclosed type.
Voltage of Circuit.—500 volts.
Switch Gear.—An approved starting switch and resistance, and minimum release.
Mechanical Gearing.—To be so arranged that crane may be worked by hand power for all motions when desired.
Alternative Offer.—An alternative offer for a three-motor crane may be submitted
Specified Date of Completion.—June 21st, 1901.
Penalty for Late Completion.—£50 per week.
Specified Terms of Payment.—Forty per cent. of contract price on delivery of the whole of the materials, 40 per cent. on completion, 20 per cent. 12 months later.
Length of Period of Maintenance.—Twelve months from date of completion.
Stipulations as to Removal of Foreman.—Satisfactory.
Stipulations as to Wages Paid to Workmen.—Acceptable. See comments below.
Amount of Surety demanded from Contractors.—Two, to be jointly and severally bound with contractor in sum of £200.
Arbitration Proposal.—Limited. See comments below.
Date for Receipt of Tenders.—November 22nd, 1900.

The specification before us has been prepared by Mr. H. Faraday Proctor, A.M.I.C.E., M.I.E.E., the city electrical engineer of Bristol, and asks for the supply and erection at the Avonbank electricity supply station of one 15-ton electric travelling crane.

The span is 47 feet 9 inches, the total vertical lift 45 feet, and the test load 1¼ times the normal load.

Although offers are asked for one motor capable of working the three motions, hoisting and longitudinal and transverse travel, it is open to tenderers to quote as an alternative for three-motor cranes.

It is expressly stated that only tenders from crane manufacturers will be considered, the motor mentioned in the specification being of Messrs. Siemens' semi-enclosed type, though this latter may be "of other approved make."

Many of the general conditions are of such a character that they may be accepted by the contractor without unduly increasing the business risk of the contract, but in several particulars modifications may fairly be asked for.

Powers are reserved by the following clause to the engineer to extend the due date of completion, should any unavoidable cause have delayed the work.

This is only reasonable, though in some specifications the wording of the clause is such that no alteration is permissible.

> The contractor shall commence the erection of the crane and other goods covered by this contract not later than June 1st, 1901, and he must complete the whole of the works by June 21st, 1901.
> Provided always that if *any general strike or other unavoidable cause shall*, in the opinion of the engineer, *have unduly delayed or impeded the contractor in the completion of the contract, it shall be lawful for the engineer to grant an extension of time*, if he shall think fit, *without affecting the validity of the contract.* If the engineer, in exercise of any power vested in him by the contract, shall substitute another date, in writing, for the completion of the works, the contractor shall complete the same by, or before, the substituted date, as though the same had been originally inserted in the contract. Should the contractor fail to complete the works at the times and in the manner specified in the contract, *he shall pay to the Corporation, by way of liquidated damages, and not as a penalty, the sum of £50 per week for each and every week during which the works remain incomplete.*

Another good feature is the manner in which the conditions as regards maintenance are stated. The onus of proof of fault on the part of the contractor is thrown on the Corporation, and results of acts of wilful carelessness on the part of the servants of the Corporation are expressly excluded from the operation of the clause. As worded, it reads:—

> *The contractor* shall, for a period of 12 *months after the date of the engineer's certificate of completion, maintain the work and keep it in perfect repair.* If, during this time, any defects of materials or workmanship should appear, or if the efficiency of the work should in any way deteriorate, the contractor shall forthwith make good such defects or deterioration at his own cost, and to the satisfaction of the engineer.
> In the event of the contractor failing to comply with the stipulations of this clause, it shall be lawful for the Corporation to make good any defects and deterioration, and deduct the cost of this from any money due, or to become due to the contractor. *Provided always that the contractor shall not be liable for damage to the work after completion, and during the period of maintenance, if such damage shall have been caused by fire, or by any wilful act, or neglect of the servants of the Corporation, or by fair wear and tear.*

If any part of the materials supplied are found to be unsuitable, it is open to the Corporation to make use of the rejected parts on paying 5 per cent. per annum of their cost price. This power is contained in the following stipulation:—

> If the work, or any part thereof, fails to pass the standard of test specified, the engineer may totally reject such work or part thereof, and the contractor shall submit to a deduction being made from his contract price according to the schedule of prices hereto annexed, or, where the rate is not contained in the schedule, according to the estimate of the engineer, in respect of such rejected work, the intention being that it shall be lawful for the Corporation to obtain, without additional cost, the particular work from another party if the present contractor shall fail to carry out any works, or part of works, in strict accordance with the specification. *In the event of the Corporation rejecting the works, materials, or plant supplied, or any portion of such works, materials, or plant, they shall have power to retain and use them, paying for such use the sum of £5 per cent. per annum upon their value, until such time as they can substitute other suitable works, materials, or plant in place thereof.*

Sub-letting is forbidden except by express permission of the engineer:—

> The contractor shall not underlet or sub-contract with any person or persons for the execution of any portion of the work without the written consent of the engineer, nor shall he assign the contract without the written consent of the Corporation.

The clause relating to wages to be paid to workmen may be accepted by any firm of high standing. It reads:—

> The contractor shall pay his workmen the rate of wages generally accepted as current for a competent workman in his trade, under a penalty of £50, or under pain of forfeiting the contract, at the option of the Corporation.

and may be considered as an interpretation of the fair wages clause, which should be acceptable to all parties.

One curious stipulation reads:—

> In case the terms of the contract are not duly performed, the party failing to perform the same shall (in addition to any other liability under the contract) pay to the other party a penalty of £1.

We wonder that more of those municipal engineers who either hold or have held prominent positions in the Municipal Electrical Association, do not adhere to the wording as agreed upon between the representatives of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association.

The arbitration proposal made in the specification is limited in its application, several important points, especially any relating to the correct interpretation of the specification, being left to the sole decision of the engineer. The actual wording is:—

> If any dispute or difference *(exclusive of all questions within the powers of, or which are to be determined by the engineer)* shall arise under this contract between the Corporation and the contractor upon any matter whatever arising out of this contract, such dispute

or difference shall be referred to an arbitrator, and this contract shall for such purpose be a submission under the "Arbitration Act, 1889."

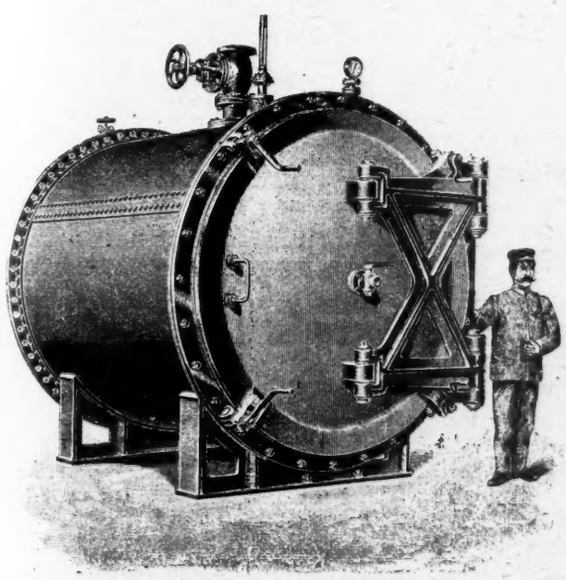
while the phrasing of the model clause is :—

In case *any dispute or difference shall arise* between the purchaser, or his engineer on his behalf, and the contractor, *either during the progress of the works, or after the determination, abandonment, or breach of the contract, as to the construction of the contract,* or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may, within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration within the meaning of the Arbitration Act, 1889.

We consider that to be of real value the operation of an arbitration clause should be unlimited, and tenderers no doubt have stipulated to that effect.

VACUUM DRYING APPARATUS.

The patent vacuum drying apparatus, of which Herr Emil Passburg, of Bruecken-Allee, 33, Berlin, has long made a speciality, is very largely used by Continental manufacturers of cables and electrical machinery, and an effort is being made to bring it more prominently before the attention of similar firms in this country. These dryers are employed in a very large number of chemical and explosive factories in Europe, and, judging from the number of repeat orders received, the service they have rendered has been more than satisfactory; but we are concerned chiefly with their application in the electrical manufacturing industries, and a few circulars which are before us contain not only brief descriptive notes and illustrations, but also a list of some of the more important electrical factories and electricity works which are using the apparatus. Such firms as the Union Electricity Company, of Berlin, the Helios Company, Messrs. Brown, Boveri & Co., Messrs. Siemens & Halske, and the General Electricity Company, of Berlin, are among the Continental cable, dynamo, and motor factories, and Messrs. Felten & Gilleaume, and Messrs. Pirelli & Co. (Milan), are listed among the india-rubber works where Mr. Passburg's machines are at work. The English users include the India-Rubber Company, of Silvertown; Mr. Isidor Frankenburg, of Manchester; Messrs. Reddaways, of Manchester; Burroughs, Wellcome & Co., of London; and Electromotors, Limited, of Manchester. No doubt as the dryer becomes better known, its use in this country will rapidly extend, particularly among the large number of dynamo and motor makers and cable manufacturers. It is made of cast or wrought-iron of various sizes and construction, according to the particular class and extent of work for which it is required.



The apparatus is designed to remove the water thoroughly, rapidly, and at low temperature from materials, bringing about a great saving in time, fuel, cost of plant, and working expenses.

The apparatus consists of a cast or wrought-iron chamber, or cylinder, which is closed hermetically at one or both ends by doors. The apparatus contains a number of closed steam or heating shelves or pipes, arranged one above the other, or round the sides of the dryer. The shelves are, as a rule, made strong enough for a pressure of 75 lbs., the pipes for a higher pressure. On these are placed iron, copper, galvanised perforated iron or earthenware trays, or trolleys which contain the material to be dried. After the door, which is fitted with an india-rubber joint, has been closed, a high vacuum of at least 28 inches of mercury is created by means of an air-pump, whilst exhaust or live steam passes through the heating shelves or pipes. At a very moderate temperature of the material to be dried—about 95° F. (35° C.)—the water in the corresponding vacuum begins to evaporate briskly out of the substances, and the latter dry rapidly. The charging of the chamber is simple, and its working clean and reliable. The temperature may be regulated by valves in the steam pipes. As to the steam consumption, we understand that this is very small. As a rule only 1·2 lb. of heating steam is required to evaporate 1 lb. of water out of the previously heated substance that is to be dried. This includes the motive power for the air-pump, where the exhaust steam from the air-pump engine is used for heating purposes. Such an economical consumption of steam is only possible by drying under vacuum. Summed up in a sentence, Herr Passburg claims for his system that it is a rapid and economical method of drying material for electrical manufacture, at a very low temperature. The dryers for india-rubber and chemicals used for vulcanising are made for a capacity up to 3 tons of rubber per 24 hours. A drying chamber of No. 5 size, which occupies only 8 feet × 6 feet 6 inches × 8 feet, will dry 2 cwt. in one or two hours, or 1½ tons of wet rubber in 24 hours. Size No. 9, which is for dynamos, motors, large anchors, bobbins, and such like work, is shown in our illustration.

An important factor with this drying system is the combination with the apparatus of a testing arrangement, which tells exactly when the drying process has been terminated. With the manufacture of cables this is especially important, as the expensive un- and releading of an insufficiently dried cable cannot occur; in a similar way it also refers to motors and dynamos, where not unfrequently the copper under the insulation has oxidised through the latter not having been sufficiently dried before being impregnated, and it is therefore of the utmost importance that the insulation should be as absolutely dry as possible before being dipped. As this is only possible under vacuum, which process is again quite independent of climatic influences, the vacuum dryers have proved to be an important acquisition to electrical manufacturers.

ELECTRIC SHOCK FATALITIES.

The Newport Accident.

An adjourned inquest was held at the Town Hall, Newport (Mon.), on Friday last, touching the death of Mr. Thomas William Griffiths, electrician at the Newport electrical works, whose death occurred on Monday afternoon, November 12th, under circumstances which are shown by the evidence hereafter. The Mayor of the borough was on the bench with the Coroner, as well as two factory inspectors (Mr. Augustus Lewis and Mr. T. O. Edwards) representing the Home Office.

Fred. Arthur Watkins, switchman at the works, said: The deceased was one of three electricians in charge of the works under Mr. Copland, the manager. The accident happened on Monday, November 12th, at 3.55 p.m. Deceased was behind the switchboard, where he had gone after receiving a telephone message from one of the jointers on the mains. Mr. Griffiths asked witness to hold up the cable, which he was going to connect on to the circuit. The current had been stopped at No. 4 panel to allow the men outside to work on the cable. No one was allowed to go behind the board unless some one in authority went with him; it was necessarily a dangerous place. Deceased should have had india-rubber gloves on; they were kept on a table in the switch room. He was contravening the regulations of the works in not putting them on. India-rubber insulating mats were laid the whole length of the switchboard, and there was plenty of room for four or five men standing abreast. Deceased had misplaced a spanner, and was crouching in front of No. 4 panel, and said, "Where's the spanner?" The next thing witness saw was a flash and deceased rolling over on his back. There was no smell of burning. Witness did not see clearly what he touched, but he must have come in contact with some live terminals. From what he saw afterwards, he thought his left knee must have touched a terminal. When witness saw what had happened, he went to the top of the switch room steps and shouted for help. One or two others came up and tried artificial respiration. A notice showing diagrams from the Electrical Review illustrating modes of artificial respiration was hung up in the room, and attempts were made for 35 minutes to promote respiration. A medical man was sent for at once. There was more than 4 feet clear space between the switchboard and any wall.

In answer to the chief Home Office inspector, Witness said a typewritten letter was fixed up in the switch room warning persons not to make connections or do switch work without the aid of gloves and mats provided for that purpose. Witness did not have gloves on. The only other person behind the board was a pupil.

Percy Charlton, a student at the Newport electricity works, said he went behind the switchboard to see some gear which had been tested. He saw deceased working with a spanner on a terminal of the dead panel. Witness saw a flash reflected along the panels, and noticed deceased spring up into the air and fall on his back. He groaned a little, and doubled himself up. Witness ran after Watkins and shouted for help, and then pulled deceased away and straightened his legs out.

cause shall, in the opinion of the engineer, *have unduly delayed or*

upon any matter whatever arising out of this contract, such dispute

Arthur Harold Felton, one of the electricians in charge, said he was called after the accident to help the deceased. A little piece of scorched cloth, corresponding with a rent in the knee of deceased's trousers, was seen on the live terminal.

In answer to the Home Office representative, Witness said the iron door leading to the back of the switchboard was not necessarily kept locked, but anyone going behind would have to speak to the electrician in charge. He should also consult the log sheet kept in front. Witness did not always wear gloves when working behind the board, and said he did not think he should alter his practice after the accident. Of course, if an accident occurred, he would have himself alone to blame. A man could work better without than with gloves.

Charles Dalziel Copland, borough electrical engineer, said he had been in charge of the works since 1895. He went to Newport as Mr. Hammond's local engineer in 1894, and ever since then he had had an intimate knowledge of the station. Deceased was employed at the works in 1896 as an electrician to take charge. He had had a previous short experience at Leeds. Witness had worked without gloves just in the same way as the deceased.

The Coroner: Familiarity has bred contempt then?

Witness: Well, not that exactly. With india-rubber gloves one must be quite sure that they are perfect, or else there may be more danger than working with the open hand. A hole as big only as a pin will admit current. He should, however, expect anyone working at the terminals, alive or dead, to wear gloves. He did not think anything could be done to make a switchboard less liable to accident without still more complicating matters. No doubt the deceased was in an unsteady position whilst crouching down to connect the circuit terminal with the earth main, but he did not think the suggestion of Mr. Lewis (representing the Home Office) of raising the working place so as to allow of a man working in a standing position was practicable, because it would involve raising the plugs too high for practical purposes. The switchboard was designed and supplied by Fowler's, of Leeds, and he thought it was the best board of the sort that could be made. There had never been a serious accident at the works before. There was no doubt that if the deceased had worn gloves he could not have got the fatal shock. He was an experienced man.

The result of the post-mortem examination made by Dr. Vines and Dr. Macormack was stated by the latter gentleman. The heart was dilated and the blood dark, but the left side of the heart was contracted. The lungs were healthy. The liver was very much enlarged. Further examination of the heart and liver showed that both were in a diseased condition; with the organs in this state a very slight shock would kill him, and he was even liable to die at any time. He considered that, having regard to the fluid state of the blood, the cause of death was an electric shock acting upon a diseased heart. It was difficult, however, to say whether the deceased fell and then fainted, or fainted first and then fell against the live terminal. The immediate cause of death was paralysis of the heart. The deceased, with such a heart and liver, would not live long in any case—probably not more than two or three years.

After the Coroner had delivered an address, the jury returned a verdict that death was due to paralysis of the heart, caused by an electric shock. They exonerated the officials of the works from all blame, and considered that Mr. Copland, the chief electrical engineer, had taken all necessary precautions, but they thought that in future the management should see that gloves were worn.

The Marylebone Accident.

On Thursday last week Dr. George Danford Thomas, coroner for Central London, held an inquiry at the Marylebone Coroner's Court into the circumstances attending the death of Rowland Herbert Peckworth, aged 22 years, an assistant electrical engineer, who died from an electric shock whilst at work at the Metropolitan Electric Supply Company's works at South Street, Marylebone, on Tuesday morning, 13th inst. Mr. G. Blenkensopp, H.M. Inspector of Factories, watched the case on behalf of the Home Office.

Reuben Peckworth stated that the deceased, his son, had been in the employ of the Metropolitan Electric Supply Company as assistant electrical engineer at their works at South Street, Marylebone, for 18 months, and he enjoyed excellent health. On Tuesday morning he received a telegram informing him of the death of the deceased, and he afterwards heard that the deceased was engaged at the works in putting in a switch at the switchboard, when his hands, by some means, came into contact with the current, and his death was instantly caused.

Guys Branden, a switchboard attendant in the employ of the Metropolitan Electric Supply Company, stated in answer to questions by the Coroner, that men engaged at the works were instructed as to their duties and what precautions it was necessary to take. Gloves were provided for use in the work. On Tuesday morning at seven o'clock witness went to the works and found the deceased there, at work. At half-past eight he and the deceased were engaged in connecting some large cables with the switch. Deceased would not wear gloves but would use insulated handles, and if such were used the work could be done with perfect safety. He turned round and saw the deceased falling; he then noticed that deceased had received a shock, he evidently, instead of taking hold of the insulated handle, having taken hold of the metal work with both hands, the result being that the current had passed through him. He pulled him away by taking hold of his coat. Means were at once used to restore him, but without avail. A doctor was called and it was found that he was dead.

A Juror asked if there was any likelihood of witness receiving a shock in pulling the deceased away?

The Witness said that there was if he had attempted to pull him away by the hands, and therefore he took hold of him by the coat.

By the Coroner: There was no doubt but that the deceased took hold of the switch thinking at the time that it was not charged. Deceased could see by a lamp overhead whether the current was on or off.

The Coroner said that deceased must have by mistake taken hold of the metal and got a current through it.

Arthur Wyatt, superintendent of the South Street station, stated that the deceased had been an assistant for 18 months, and he was well acquainted with the duties and regulations with regard to what precautions it was necessary to take for safety. There was at the works a large switchboard, and there were certain connections with it, in fact, over a dozen. The connections could be made with perfect safety if the deceased took hold of the insulated handle. The switchboard itself was insulated. Deceased went on night duty and had been at work all through the night receiving current from the station at Willesden. Witness went to the works about half-past nine on Tuesday morning and then found that the deceased was dead. The deceased had evidently intended to make a connection and he took hold of a switch with both hands, evidently having forgotten that the switch was fully charged, and the result was that the current passed completely through him. Had deceased looked above his head he would have seen whether the current was on or not by the pilot lamp. At the time of the accident the voltage was 1,000. In reply to the Coroner, the witness said that he examined the machinery and found nothing amiss with it. The work that deceased was doing was similar to that which he would do every day.

By the Factory Inspector: There was nothing to prevent deceased touching the metal if his hand slipped. There was exposed metal on the switchboard. If the switch was taken hold of by the handle all was safe.

Dr. John Pollock Simpson stated that he was called to see the deceased, and found him dead. The hands were both destroyed, clearly showing that electricity had passed through the body from one side to the other, and death was caused instantly from shock.

Reginald Todd, chief engineer to the company, said that the ordinary precautions were taken for the safety of those engaged at the works, and to enable anyone to see whether the current was on a switch, there was a pilot lamp above. It was evident that in this instance deceased took hold of the switch by the metal portion with both hands, thinking the current was off. He would consider whether it was possible for some method to be adopted by which a similar accident could be avoided in the future. The switch was constructed so that it should be used by one hand only, and to prevent the hand slipping from the insulated handle on the bare metal there was a flange at the end of it.

George Blenkinsopp said that he had visited the works, and found that there was certain metal on the switchboard that was exposed. In 1896 a Royal Commission made a number of recommendations, one being that with regard to switchboards all metal work should be insulated or means taken to make it impossible for workers to touch it. The recommendations of the Committee had up to the present not been put in force by the Home Office authorities.

The Coroner said that he should not advise the jury to recommend in their verdict any particular kind of protection to be taken, because they, as laymen, might recommend something that might be unsuitable. They had better leave it to the company to find out what was the best method to adopt.

The jury returned a verdict that the deceased died from the effects of shock from electricity arising at a time when the deceased's hands came in contact with the electric current of a switch when he was changing the current, and that the death arose from accidental causes. The jurors would recommend to the immediate consideration of the company the necessity of protecting the metal switches in such a manner that a similar occurrence cannot happen again.

THE AUTOMOBILE CLUB TRIALS OF ELECTRICALLY-PROPELLED VEHICLES.

The Automobile Club of Great Britain has done good service to the electric vehicle industry of this country by inaugurating the trials which we described in our last issue, and the best thanks of those interested are due to the Club and to the judges and observers who gave much time and patience, as well as to the secretary of the Club for his able organisation under very difficult circumstances. The results obtained under great disadvantages must be accepted as proving the practicability of electrical propulsion on common roads. The trials in every way established the commercial utility of the electro-mobile once for all in this country. The long-distance run on rough roads and through hilly districts on one charge, the case of control, their reliability, smoothness in running, absence of vibration, and economy of electric energy, make the electrically-propelled carriage an assured success.

One of the conditions (7) was that the place of assembly and routes were not to be made known to the competitors until shortly before the trials. This was an unusual condition, and is believed never to have been previously made imperative in the trials of petrol cars. It is difficult to understand the reason for such precaution, and certainly it had the very great disadvantage of not letting the public or those interested know where to view the carriages *en route*.

The station chosen, as our readers have already been informed, was Chislehurst; the stables and yard in which the carriages were assembled quickly became a quagmire, owing to the extremely wet weather and heavy traffic. The station engineers, however, did their very best to make everybody comfortable, but the mud rendered it impossible to give proper attention to the cars.

The conditions hitherto applied to petrol cars are not altogether suitable for electric cars. When petrol cars stop the engine still continues to work, whereas the opposite is the case with electric cars.

As to the conditions of the trials, the charge taken by each carriage was recorded each day. The method of observation during the runs by noting the time and current taken every five minutes was open to question, and was certainly not strictly reliable, as it did not take into account the intervening reading. As an example, when going downhill a mile could have been run in the five minutes, and no record taken of the small current used. The mean of the readings are useful as a guide, taken with the drop of voltage during the run, and the total watt-hours could be calculated from a curve of the same battery discharged at approximately the same rate as during the trip. The results, however, when they are made known, will doubtless be instructive.

Another condition was that all stops on the journey other than for traffic, or without reasonable cause, should be taken as running time. This, however, would make any calculation of watt-hours per ton-mile impossible. It was stated as a reason for this condition that electric batteries recuperate during stoppage. This is not exactly correct; a stop does allow the depolarising gas to pass off, and the battery starts fresh with all possible E.M.F., but this is an advantage inherent to electrically-propelled vehicles, and is a most useful feature at the end of a long journey.

The route chosen for the first day's run was over exceedingly hilly country, with long gradients of 1 in 40, 1 in 20, and short hills of 1 in 10; the route bristled with notice boards—"Caution to cyclists, this hill is dangerous." In the whole 35 miles there did not appear to be five of level road. Two expert cyclists who followed the cars on this day, described it as "mountain climbing and mud pushing," and stated they would rather cycle the 50 odd miles from London to Brighton than the 35 miles chosen, and this was the generally accepted opinion. The weather was unpropitious; it was raining and cold, and the roads were very heavy in places; as a consequence, anything like long distance runs, or good average speed was impossible. The speed down hills had to be repeatedly checked for fear of side-slip. In spite of all this, five of the seven carriages that started ran practically the whole distance. One carriage ran nearly 60 miles, and a smaller vehicle 37 miles on one charge.

The second day's run was taken as a hill-climbing test, and all the five carriages did the distance, two of them running about five miles in addition.

The third day's run was about 30 miles on the same roads as the first and second days' trials; four of the five carriages did the distance, and the other one had trouble with its chain gearing owing to clogging of bearings with road sand.

The fourth and last day's run was optional, but four of the carriages did long journeys.

On the whole, under the more than ordinary difficulties, the four days' successive spins were made with an aggregate of about 600 miles for the five vehicles, or an average of about 30 miles per day for each vehicle with hardly a mishap.

It will be interesting to compare these with some experimental trials of electrically-propelled vehicles recently made in America. The figures given of these trials, as the result of many runs, varied from 25 watt-hours per ton-mile* on slight down grades, to 200 watt-hours per ton-mile on slight up grades over very rough road, cobble and macadam; the average results obtained on streets of New York with some gradients of 1 in 40, being 100 watt-hours per ton-mile (English ton). The cost of 100 watt-hours per ton-mile at 3d. per unit, comes out at two-thirds of ½d. In a recent run of an electric carriage from London to Brighton, 53 miles, on one charge, through very hilly country, but with good roads, the journey was made at an average speed of 10 miles per hour for 150 watt-hours per ton-mile, which, at 3d. per unit, is practically ½d. per ton-mile, an allowance of 25 per cent. being added for loss in charging. This result agrees with the figures obtained in New York, and tends to confirm the favourable opinions formed as to the future of electrically-propelled vehicles.

* Reduced to English weight.

One of the most interesting features in the Club trials was the recuperation, or charging the batteries, down steep hills; on some of the hills as much as 25 per cent. of the maximum current taken in ascending, was returned when descending the other side, and this was taken advantage of by several of the demonstrators.

The experience gained by electric carriage builders during the trials was worth all the cost and vexation, such experiments tending to develop a most promising industry.

We would suggest that tests in the future should be arranged by a joint committee of the Club and the competitors. The time, place, and routes chosen should be made public some weeks beforehand.

The trials should be real efficiency trials, somewhat as outlined below:—

1. Vehicles divided into classes and countries.
2. *Electrical.*—Electrical efficiency points for:—

1st day.—Three short runs 1 to 2 miles in three speeds of 3, 6, and 12 miles, with self-recording meters. 1. On level roads. 2. Grades 1 in 40 to 1 in 80. 3. Grades 1 in 10 to 1 in 20. Nine runs in all; each competitor at his very best.

2nd day.—Long run without limit as to distance, reasonable stops allowed, into the country and back, starting from a centre in London. Take readings every 2 minutes, and drop in volts, and gradients measured to compare with first day's tests.

3rd day.—Run of 30 miles from London to suburbs. Readings as before, &c.

4th day.—30 miles in London streets. Readings as before, special note being taken of control.

The motors and batteries should be tested as to suitability and efficiency. The system of control and circuit should be considered.

3. *Mechanical.*—Mechanical efficiency in pounds per ton-mile to pull carriage on level roads. This to enable accurate calculations being made. Design of carriage and comfort of passengers. Construction of carriage, method of placing motors, batteries, &c. Gearing. Brakes. Steering arrangement. Weight and proportion of battery and motor to carriage; proportion of whole carriage to useful carrying capacity.

The committee might elaborate these points, and the trials would then give sufficient data to enable the proportions of battery weight to load-carrying capacity to be determined. In the recent trials one carriage weighed 2½ tons and carried two passengers, while another carriage weighing only about 16 cwt., also carried two passengers. Of course the larger carriage made longer distances, but the why and wherefore must be reduced to rule. The best gearing, motors, batteries, and system of control could be more nearly determined, and much interesting data as to road friction, windage, power required for inclines, &c., could be arrived at, and would be most acceptable to the new industry.

CORRESPONDENCE.

Comparative Cost of 110-volt and 220-volt Supply.

When we were supplying at 110 volts on the networks, we were charging on the "number-of-lamps-installed" basis—*i.e.*, during the winter quarters a consumer had to use eight units per 8-C.P. lamp installed per quarter, and during the summer quarters two units per 8-C.P., making in all 20 units per 8-C.P. lamp per annum to be charged at 6d.; any units over and above were charged at 3d. With the

shock in pulling the deceased away?

assured success.

220-volt supply we are charging on the maximum demand basis, the price being 6d. for the first hour and 3d. afterwards.

Average Price per Unit Charged.

Consumer's number.	110 volts. March.	June.	Sept.	Dec.	220 volts. March.	June.	Sept.	Dec.
37 ...	6·0	6·0	6·0	5·8	6·0	3·0	5·9	3·2
57 ...	6·0	6·0	6·0	6·0	6·0	6·0	6·0	3·6
82 ...	6·0	6·0	6·0	6·0	6·0	6·0	6·0	5·4
106 ...	6·0	6·0	6·0	5·9	6·0	6·0	6·0	3·3
107 ...	6·0	6·0	5·8	5·2	4·7	6·0	6·0	3·8
114 ...	6·0	6·0	6·0	6·0	6·0	6·0	6·0	4·0

I enclose a few instances showing the average price obtained when charging on the above systems, which may be of interest to your readers.

Horace Boot, *Borough Electrical Engineer.*

Tunbridge Wells, *November 19th*, 1900.

Cable Testing (Transformers for).

I write to point out that a method exists—and the necessary plant, also—which, for the purpose above-mentioned, cannot be beaten either on the score of prices, simplicity, or efficacy.

So simple is the method to which I refer, and so few, I presume, are those interested in the matter, that I will not take up your space with diagrams or illustrations.

I have already had the pleasure of going into this method with engineers, who have promptly expressed their satisfaction by ordering the necessary plant.

If Mr. Wright, or others, who are looking for cable testing plant, care to communicate with me at Globe Works, Harrow Road, London, I shall be happy to go into the matter with them also.

A. F. Berry.

November 21st, 1900.

Aluminium Jointing.

In the review of Mr. Wm. Maver's article which appeared in the October number of our magazine, Mr. J. Wright in the current issue of the Electrical Review, states:—"Another drawback to the use of aluminium which has, I think, deterred English manufacturers from employing it in this connection is the difficulty of making an effective joint, there being at present no satisfactory method of soldering it, although several apparently satisfactory mechanical devices have been mooted for this purpose."

It may interest you to know that this difficulty has now been solved in America. A few weeks ago we had an inquiry from a firm of optical instrument makers, who asked us whether we knew of a satisfactory solder for aluminium, and on making inquiries, we found that in America, a Mr. Richards was manufacturing a solder which had proved very successful. We obtained some for our correspondents and asked them to let us know what results they had, and in reply they informed us as follows:—"We have received the sample of Richards aluminium solder and the pamphlets, and we are pleased to tell you that for the first time we have been able to successfully solder aluminium. This metal may now become extremely useful."

We are at a loss to understand why this solder has not been introduced into this country, but if Mr. Wright would care, we would obtain some of this solder for him, which he could test for himself.

For the Editor, *Cassier's Magazine*,
E. G. King.

November 15th, 1900.

Once Bitten——.

I should be much obliged to have your opinion in regard to an experience of mine. A few weeks ago I was one of the selected candidates, six in number, to appear before the Electric Light Committee of a certain town of Erin, and was informed that my second-class fare would be paid. I accordingly accepted the invitation, undertook the railway journey on a cold, wet morning, leaving home at 9.0 a.m. After a most wearisome time in the train, I was treated to a variety entertainment on the briny, and after passing safely through some other critical ordeals, I duly arrived at this most important town of ——.

The next morning the other five candidates and myself were interviewed, and, fortunately for me, I was not the successful candidate. I was told to forward my expenses to the clerk, as the Committee did not require us any further. After a long wait at this large town, and an even more impressive variety entertainment—in a full gale—on the briny, and later a long wearisome railway journey, I—or what was left of me—arrived home cold, weary, and sad at heart.

A few days later I forwarded my expenses, as requested, but received, after waiting several days, a cheque for my railway fare only, with a polite intimation that no other expenses could or would be allowed.

I should like to know, Mr. Editor, whether anyone else has had a similar experience, and would strongly advise all my brother engineers to take warning by my case, and never cross the briny to "Old Erin" without having in writing a distinct understanding that all out-of-pocket expenses will be paid. Of course, this warning does not apply to England, where these matters are more justly and even generously dealt with.

One of the Six.

THE LONDON ELECTRIC LIGHTING AREAS.

A proposal of great moment, affecting the areas of supply of electricity undertakings within the metropolitan area, is foreshadowed for the coming session of Parliament. The Board of Trade is the promoter of the application, which is published in last Tuesday's *London Gazette*. The following is an abstract:—

To provide for the alteration and readjustment of the areas of supply of electricity within the administrative County of London or any parts detached therefrom under the London Government Act, 1899, as authorised by the Acts and Orders made by Parliament and the Board of Trade, so as to make the boundaries of those several areas co-terminous so far as may be with the areas of local government fixed by the London Government Act, 1899, and the Orders in Council authorised by and made under the provisions of that Act.

To alter and readjust to such extent as may be found necessary or expedient for any of the above purposes, or as Parliament may prescribe, the boundaries of the existing areas of supply of the authorities and companies set forth in the schedule hereafter appearing, either by extension or limitation of those areas, and for any of those purposes to vary, amend, extend, repeal, or alter such of the provisions of the Acts and Orders mentioned in the said schedule as may be found necessary or deemed expedient.

Schedule.

Authority or Company.	Acts and Orders under which the several areas are fixed.
St. Pancras Borough Council	St. Pancras (Middlesex) E.L. Order, 1888.
Hampstead Borough Council	Hampstead (London) E.L. Order, 1892.
Shoreditch Borough Council	Shoreditch E.L. Order. 1892.
Stepney Borough Council	Whitechapel District E.L. Order. 1892. Limehouse District E.L. Order, 1900. Mile End Old Town E.L. Order, 1900. St. George-in-the-East E L. Order, 1900.
Hackney Borough Council Stoke Newington Boro' Council	Hackney E.L. Order, 1893.
Hammersmith Borough Council	Hammersmith E.L. Order, 1893.
Islington Borough Council	Islington E.L. Order, 1893.
Poplar Borough Council	Poplar District E.L. Order, 1893.
Battersea Borough Council	Battersea E.L. Order, 1896.
Fulham Borough Council	Fulham E.L. Order, 1897.
Southwark Borough Council	Newington E.L. Order, 1897.
Barnes U.D.C.	Barnes E.L. Order, 1898.
Hornsey U.D.C.	Hornsey E.L. Order, 1898.
Bermondsey Borough Council	Bermondsey E.L. Order, 1899.
Bethnal Green Borough Council	Bethnal Green E.L. Order, 1899.
Lewisham Borough Council	Lewisham District E.L. Order, 1899.
Chelsea Electricity Supply Company, Limited	Chelsea E.L. Order, 1898.
Brompton and Kensington Electricity Supply Company, Limited	House-to-House E.L. Supply Order, 1899.
London Electric Supply Corporation, Limited	London Electric Supply Corporation E.L., 1889. London Electric Supply Corporation, E.L. (Metropolitan) Order, 1890.
Metropolitan Electric Supply Company, Limited	Metropolitan Electric Supply Company (Mid-London) L. Order, 1899. Metropolitan Electric Supply Company (West London) L. Order, 1899. Metropolitan Electric Supply Company (Paddington) L. Order, 1899.
Notting Hill Electric Lighting Company, Limited	Notting Hill E.L. Order, 1889. Notting Hill E.L. Order, 1895.
Crystal Palace District Electric Supply Company, Limited	Crystal Palace and District E.L. Order, 1890. Crystal Palace District E.L. Order, 1894.

City of London Electric Lighting Company, Limited	Southwark E.L. Order, 1891.
South London Electric Supply Corporation, Limited	Lambeth E.L. Order, 1892.
County of London and Brush Provincial Electric Lighting Company, Limited.	County of London (North) E.L. Order, 1892. Southwark E.L. Order, 1892. Wandsworth E.L. Order. 1892. St. Olave E L. Order. 1895. Camberwell E.L. Order, 1896. St. Saviour's District E.L. Order, 1896. County of London (East) E.L. Order, 1897. County of London (Northern Extensions) E.L. Order, 1897. Holborn and St. Giles E.L. Order, 1898 (No. 1). Battersea E L. Orde-. 1900.
Blackheath and Greenwich District Electric Light Company, Limited.	Blackheath and Greenwich District E.L. Order, 1-97. Blackheath and Greenwich District (Extension) E.L. Order, 1899.

To provide for the extinction, variation, or alteration, so far as may be found necessary or expedient for any of the above purposes, of any of the existing powers, authorities, rights, privileges and duties of the several authorities and companies mentioned in the foregoing schedule over or in relation to any portions of their existing areas of supply which may be detached or taken away under the provisions of the Bill, and the conferring of new powers and the extension of existing powers, rights, privileges, and duties in the case of any area of supply extended under the provisions of the Bill beyond the area of supply as now authorised.

To confirm, or provide for the confirmation by the Board of Trade of any arrangements as between company and company which may be made by any electric lighting companies within the administrative County of London for the purpose of making their areas of supply co-terminous so far as may be with the areas of local government fixed by the London Government Act, 1899, and the Orders in Council authorised by and made under the provisions of that Act, and to enable such companies to enter into agreements for the said purpose.

To make and enact all such provisions as may be necessary or expedient for enabling authorities and companies supplying or authorised to supply electricity within the administrative county of London or any parts detached therefrom under the London Government Act, 1899, to make temporary arrangements and enter into contracts and agreements for temporary purposes, and to have effect for a limited period only relating to the supply of electricity or any other matter or thing in any way incidental to or connected with such supply, and to confer upon the Board of Trade all necessary powers for enabling them to sanction, alter, or disallow any such contract or agreement.

To confer all such other rights, powers, and privileges as may be necessary or convenient for the purposes aforesaid, and to vary or extinguish existing powers, rights, and privileges which would in any manner impede or interfere with any of the objects of the intended Act.

LEGAL.

Madras Electric Tramways Company, Limited, Electric Construction Company, Limited, *v.* Cooper and Others.

In the Chancery Division of the High Court of Justice on Thursday last week, this case came before Mr. Justice Cozens-Hardy, the chief point involved being whether the first mortgagees — debenture holders—who were in possession by their trustees, were entitled to the whole amount which had been advanced and expended by them on the Madras Electric Tramways Company's undertaking, in priority to the second mortgagees. The facts sufficiently appear from the following judgment:—

Mr. Justice Cozens-Hardy, in giving judgment, said that the real question at issue was who were entitled to a sum roughly of £80,000, which represented the purchase money of the Madras Tramways undertaking, and in what priority that sum was to be paid out. There were several claimants. In the first place there were the trustees, who claimed their costs, charges, and expenses, which were not disputed, and therefore must be paid, and then there were several persons who claimed a 6 per cent. charge in priority to everyone, and they claimed for the full amount of the advances which had been made. These claimants were the plaintiffs in the action, the Electric Construction Company. There were also first debenture holders, the Construction Company being some of the first debenture holders, but not quite all. They were 5 per cent. debentures, besides which there were second debentures, half of which were held by the plaintiffs, and the other half by the British Electric Traction Company. The facts of the case were shortly as follows:—The Madras Tramways Company, which was now in the course of winding-up, borrowed money by means of the issue of a 5 per cent. debenture, and there was a covering deed to which Sir Daniel Cooper and Mr. Bartlett were the trustees. These gentlemen, as trustees, had, under the terms of the covering deed, power to take possession of the concern on the happening of certain events, which happened in 1895. In short, default was made by the Madras Company, and the trustees entered into possession. They had power to carry on the business, which they did, and in doing so spent large sums of money. One of the trustees was a director of the plaintiff company, and the money procured for the purpose of carrying on the business was furnished by the plaintiff company. This went on for some time, until in 1897 there had been a very large sum of money advanced, and under these circumstances the state of things was this:—Without the concurrence of the first debenture holders, no prior charge could be given, except by means of the requisite majority ascertained at a meeting called under the terms of the debentures. The Madras Company might get a first charge in priority to the charge of the first debenture. A transaction took place in 1897, by which the Madras Tramways Company, the Construction Company, and the debenture holders and the trustees all came together in the sense that they arrived at a certain bargain, the terms of which were contained in a deed of January 13th, 1897. That deed was made between the Madras Tramways Company of the one part, the Construction Company of the second part, and the trustees of the third part. Among the recitals of that deed it was provided that interest should be first charged on the undertaking of the property both present and future in priority to the principal money and the interest secured by the debentures. The meaning and effect of that charge was that it was a charge which gave the Construction Company an absolute first security upon all the property, and the Tramway Company gave them interest at the rate of 6 per cent. on that charge. The validity of that charge was not, and could not, be disputed. On the face of the deed it was plain that the only relation of debtor and creditor which subsisted was that between the Madras Tramways Company on the one hand and the Construction Company on the other. The Construction Company did not lend the money to the trustees, but the contract was that they should advance to the Madras Tramways Company, and the latter had to give a first charge in priority to all other charges at the rate of interest of 6 per cent. per annum. Although the plaintiff company were under no obligation to lend the Tramways Company further moneys, they did lend very large sums in addition. Upon what terms did they lend these further moneys? They were advanced upon the condition that they should be part of and subject to the security given by the mortgagors for these further advances carrying 6 per cent. interest. That system of advance was practically made, and that security was absolutely beyond question until the moment arrived in November, 1898, when the plaintiff company had notice that the Madras Tramways Company had done what they were perfectly at liberty to do, namely, issue a second debenture to the defendants, the British Electric Traction Company. He (the learned Judge) thought that he must find that the terms of the bargain were set out in the deed referred to, and that he could not, and ought not, to consider what might have been the rights of the parties if the money had been advanced by the plaintiffs to the trustees independent of such a deed. In the result, he must hold that any advances made by the plaintiff company subsequent to November 25th, 1898, when notice was given of the second mortgage, were postponed to the second mortgagees' claims.

Wolverhampton Corporation *v.* The British Electric Traction Company.

In the Chancery Division on Thursday last week, Mr. Justice Joyce had before him the case of the Mayor, Aldermen and Burgesses of Wolverhampton *v.* British Electric Traction Company. It had reference to the running powers enjoyed within the borough of Wolverhampton by the company running the train service to and from Sedgley and Dudley, the Corporation having taken powers to purchase the undertaking within the borough limits. The issue depended chiefly on the construction of Section 17 of a Provisional Order of 1880, as follows:—"If at any time hereafter any tramways are constructed or purchased in the borough of Wolverhampton by the Corporation of that borough, the promoters shall, if required by the Corporation, and if duly authorised by provisional order, or by Act of Parliament, make and maintain, at the joint expense of the promoters and the Corporation, all necessary and convenient junctions and communications between the tramways of the promoters and the tramways of the Corporation, and the Corporation and the promoters shall respectively, if empowered by Parliament, and so required, grant to each other running powers over their respective tramways, upon such provisions and terms as to compensation and otherwise, as shall be settled" by mutual agreement or by the Board of Trade.

Mr. Warmington, Q.C., Mr. Hughes, Q.C., and Mr. Underhill appeared for the Wolverhampton Corporation, and Mr. Freeman, Q.C., and Mr. F. Thompson for the defendant company.

The action was brought for specific performance of a statutory contract, by which the British Electric Traction Company were said to be under liability to sell the portion of the tramway in question within the borough limits to the Wolverhampton Corporation. Originally the rights to construct the tramway were obtained by promoters under the Provisional Order of 1880. The undertaking passed in 1893 to the Dudley and Wolverhampton Tramway, Limited, and last year was acquired by the defendants in the present action, who took over whatever rights and privileges their predecessors enjoyed. The Wolverhampton Corporation also in 1899 obtained an Act of Parliament giving them power compulsorily to purchase the tramways within the borough limits, the sum paid in consideration to be agreed upon. On September 20th the Corporation gave notice to the defendants of their intention to purchase, but the value could not be agreed upon, and Sir F. Bramwell was appointed arbitrator. A purchase price of £4,250 was, however, agreed to before the arbitrator sat, and that sum was accordingly made his award. On April 5th, 1900, the defendant company wrote that on receipt of the purchase money the deed would be engrossed, but subsequently that letter was withdrawn by telegraph, and the defendants refused to complete the contract for purchase and sale unless the Corporation gave them running powers over the portion of the line to be acquired by the municipality. In defence it was pleaded that the Corporation refused to grant the mutual running powers to the defendants to which they claimed to be entitled by

Electric Light Committee of a certain town of Erin, and was

Supply Company, Limited | Crystal Palace District E.L. Order, 1894.

Section 17 of the Provisional Order of 1880, and being apprehensive that the Corporation would sever the portion sold from the remainder of their undertaking, they accordingly refused to complete the contract. By way of counterclaim they asked for a declaration by the Court that on conveyance of the tramway in question to the Corporation the defendants became entitled to running powers over the Corporation's line.

Mr. Warmington opened the case, observing that it resolved itself into the construction of Acts of Parliament. Subject to a small point about certain parcels, it would be agreed that the substantial question was this: The defendant company said that they were entitled by statute to running powers over that portion of the tramway which was the subject matter of the contract. The Corporation denied that. He then went exhaustively through the various provisional orders and Acts of Parliament relating to the Wolverhampton tramways, summarising his argument into two contentions. First, that the defendants were seeking to apply Section 17 of the Order of 1880 to a subject matter wholly foreign to that section. It was a section introduced into the provisional order for the protection of the local authority against the promoters. It was not a section which gave additional powers to the promoters, but subjected the promoters to certain liabilities at the request of the Corporation. His second point was that in the Tramways Act of 1899 the same idea was carried forward, because Sub-Section 4 of Section 5 of that Act provided "Nothing in this Order save only this section provided shall authorise the promoters to exercise any powers within the borough of Wolverhampton." What the defendant company were actually seeking was to have running powers on a tramway within the borough, not by this Act of 1899, but by the Act of 1880, although the provision of the last Act was that they shall only have such powers as are "by this Act conferred." That was followed and confirmed by the Corporation's Borough Act of 1899, which provided by Section 54 that as soon as the acquisition authorised by Section 5 of the Tramways Act of 1899 had been carried out, the Provisional Order of 1880 should cease to apply thereto. Therefore he submitted that the contract was by statute, and that the Corporation were entitled to specific performance.

Mr. Freeman, for the defendants, said the only point he was concerned to argue was whether his clients had a right to the running powers they claimed. He submitted that Section 17 was inserted in the Provisional Order of 1880 not wholly or principally in the interests of the Corporation, but in order to secure for everyone concerned, and the public, that continuous means of transit should be preserved from outlying places like Dudley and Sedgley into the heart of the borough of Wolverhampton. Its object was, that the Corporation should give necessary facilities, so that passengers should under no circumstances be enforced against their will to alight at the borough boundary merely because it stood at a particular point. On a fair reading of the section, what was to take place was this:—If the Corporation had constructed a tramway within the borough, and someone outside had brought up a tramway to the other side of the borough boundary, then the promoters, if so required by the Corporation, should make the necessary junctions and communications to join up the two lines. In this case the line within and without the borough boundary was in actual physical continuance, and it did not, he submitted, lay within the power of the Corporation to say that because they did not require the promoters to do that which was impossible, viz., make junctions and communications, because these, in fact, were already made, therefore the second part of the section which related to running powers did not arise. The language was plain, that if the Corporation was so empowered—as, in fact, it was so empowered—and was required by the promoters—as it had been required—to grant running powers, then the Corporation "shall" grant such powers. Apart from the legal obligation, the arrangement was absolutely fair, because the company running trams over the Corporation's lines would receive only the cost of so running, and the profits would go to the Corporation. It would be a gross public inconvenience if either party was entitled to cut arbitrarily the already existing line, or to stop the through running of the trams.

Mr. Thompson followed on the same side.

Mr. Warmington replied on the arguments, observing that his learned friends had endeavoured to persuade his Lordship to decide on what they believed to be the interests of the public, rather than on the words of the Act of Parliament. This was a special clause for the benefit of Wolverhampton only, and not for the benefit of the public as apart from the interests of the borough. The duty cast upon the promoters was the making of communications with something else, not with nothing else. Here there was nothing else. It was clear that the section contemplated a joining up of a Corporation's tramline, and an independent undertaking by promoters outside the borough, and to get over the difficulty, the defendants had been driven to argue that part of the tramways of the promoters ceased to be part of the tramways of the promoters, and became other tramways when purchased by the Corporation. An Act of Parliament could do a good deal, but except in very clear words, it could not make such a change as that.

Mr. Justice Joyce intimated that he would consider his judgment.

The National Telephone Company *v.* Gulliver & Co.

In the Westminster County Court, on Monday, the case of the National Telephone Company *v.* Gulliver & Co., came before his Honour, Judge Lumley Smith, Q.C., and a special jury, and was a claim for £17, a year's telephone rental in advance from Messrs. Samuel Gulliver & Co., wine merchants, of Argyll Street, W. The defendants counterclaimed £20 damages against the plaintiff company for failing to carry out their contract to give a telephone service.

Mr. Compton Smith was counsel for the plaintiffs, and Mr. Minton-Senhouse for the defendants.

It appeared from the case for the plaintiffs that an ordinary agreement was entered into in 1898 under which defendants' works at Belvedere Road, S.E., and their premises at Argyll Street were connected with the company's service. The rental was to be £17 a year in advance, dating from the date of the completion of the service—December 12th. There was a difficulty at first, and the company consented to make a rebate by starting the year from February 14th, 1899. The first year's rent was paid, and defendants, when the next amount was due, February 14th, 1900, wanted the annual date altered to April 1st. That was not done, and it was necessary to sue for the year's rent, in advance, payable on February 14th last. There was a deal of correspondence, defendants were "cut off," and decided to fight the company "tooth and nail," and go to a higher Court if necessary. The contract was for five years.

On the counterclaim a mass of evidence was called to the effect that the plaintiff company never had supplied a complete service. Under the first clause of their agreement they were to "erect and maintain, in good working order, the subscriber's exchange line and instrument," and under the second clause, they were to repair and restore the line, and use every endeavour to speedily restore communication in the event of breakdowns. Defendants' telephone used to ring up every five minutes "for nobody," and when required, was found not to be in order.

To rebut this, evidence was called by the plaintiffs to the effect that every care was taken to attend to any complaint at once, and give the defendants the best service possible in telephonic and electrical knowledge.

Counsel on both sides addressed the jury, and Mr. Compton Smith pointed out that the contract early set out that the conditions were "subject to the performance by the subscriber of the conditions herein named." Defendants did not perform them, because they did not pay their rent—one of the conditions—so plaintiffs were justified in stopping the service. On both sides the case was regarded as one of importance.

The jury found on the claim for the plaintiff company, and on the counterclaim for the plaintiff company, the latter by the Judge's direction.

Judgment was given accordingly.

Chamberlain & Hookham *v.* The Bradford Corporation.

In the Chancery Division on Tuesday Mr. Justice Kekewich had before him the case of Chamberlain & Hookham, Limited, *v.* the Corporation of Bradford by way of appeal by the plaintiffs from a decision of the taxing master as to the principle on which the costs in the action should be taxed.

Mr. Fletcher Moulton, Q.C., who appeared in support of the appeal, said that the action was one brought by the plaintiffs against the defendants for alleged infringement of a patent for an electric meter by which the amount of electricity supplied could be measured. The action was tried before Mr. Justice Farwell, who decided in favour of the defendants. When the matter came before the taxing master, he decided that the defendants, being a public body, were entitled to have their costs of the action as between solicitor and client. As a matter of fact, the real defendants were the Thomson-Houston Company. The Bradford Corporation were only nominal defendants, the fight being really between the plaintiffs and the Thomson-Houston Company. That being so, he contended that the case did not come within the provisions of Section 1 of the Public Authorities' Protection Act, 1893. As the letting out of the meters by the Corporation was only a permissive act by the terms of their provisional order, the Public Authorities' Protection Act did not apply, and the Corporation were only entitled to have their costs taxed in the usual way. Mr. Moulton submitted that the Public Authorities' Protection Act, 1893, was never intended to apply to such a case as the present. There was a great difference in a public body being "compelled" to do something by reason of its provisional order, and being "permitted" to do it. In this case the defendant Corporation were by the provisional order "permitted" to let out the meters. He submitted that all the Corporation were entitled to was to have the costs taxed in the same way as ordinary people.

Mr. A. J. Walter having followed on the same side,

His Lordship, without calling on Mr. Bousfield, Q.C., (with him Mr. Grey) for the defendants, in giving judgment, said he had not the slightest doubt about the point raised. The defendant Corporation were empowered by their Act of Parliament or provisional order to maintain electric power, and, among other things, to let out meters for hire. In those circumstances he thought the case came within the terms of Section 1 of the Public Authorities' Protection Act, 1893, and that the taxing master was right in holding that the Corporation were entitled to their costs as between solicitor and client. The appeal must be dismissed with costs.

Leave to appeal was granted.

Crompton & Co., Limited, *v.* Albright.

This case, which was believed to have an electrical interest, was in the list for hearing before Mr. Justice Farwell, in the Chancery Division on Wednesday.

Upon the case being called on, Mr. Reginald Bray, Q.C., stated that the parties had come to terms, and his Lordship would not be troubled to hear the case.

His Lordship: I suppose the parties are *sui juris?*

Mr. Bray said that they were.

His Lordship: Very well.

Pulvermacher *v.* Mott.

On Tuesday, in the Westminster County Court, the case of Pulvermacher *v.* Mott was tried by his Honour, Judge Lumley Smith, Q.C., and was an action brought by Messrs. Pulvermacher and Co., Limited, of the Galvanic Establishment, 194, Regent Street, London, W., to recover four guineas, the balance of the price of a galvanic belt, from H. Mott, a cycle maker, of Oxford.

Plaintiffs' case was that in September a "galvanic concentrated combined belt" was sent to defendant at his request. The price was five guineas, and he sent a guinea on account, and agreed to pay the remainder by instalments. Some months after the belt came back by post with a request that a portion of the guinea should be returned.

The defendant said he had paid so much for medicine that he asked to be allowed to pay by instalments for the belt. After wearing it for a time he began to suffer from headaches, and he became so bad that he laid in bed unconscious.

Mr. Noah Mitchell, managing director of the plaintiff company, denied that defendant's illness could be the result of wearing the belt. Many thousands were worn. They generated oxygen and hydrogen in the muscles. He produced a book entitled, "What Galvanism, Nature's Chief Restorer of Impaired Vital Energy, Has Done and is Doing," a copy of which was handed to the judge, who proceeded to ask many questions, in answer to which the witness said galvanism produced oxygen and hydrogen through the circulation, the liquid matter, the blood, the moisture and the nerve matter.

His Honour: Not the bladder?

Witness: Nothing to do with the bladder.

His Honour: The liver?

Witness: The liver, kidneys, muscles and stomach.

In answer to further questions, he said "concentrated" meant there was a battery every half inch, and went on to speak of cells.

His Honour: How do you spell *cells?*

Witness: C-e-l-l-s. He went on to say the belt would cure, not cause, headaches, and called attention to a copy of a letter in the book mentioned, in which it would be seen a belt was supplied to the late Charles Dickens, the novelist.

His Honour said it was an order, but Dickens could not be cross-examined about it now. He then quoted from the book a line about "curative efficacy in all the ailments flesh is heir to," referring to galvanism.

Witness said that did not include fever, and said they did not undertake to cure anyone. The belts lasted about 18 months, or until the zinc was eaten away. Defendant required it because he was low-spirited, irritable, and over-worked. He drew attention to the testimonials in the book.

His Honour said one on page 75 was certainly a good one. The writer said:—"For three years I was a victim to the unspeakable horrors of melancholia; so desperate did I consider my plight, that more than once I made attempts on my life." Could a person hang himself with one of these belts?

Witness said they could not. Did not know how much they cost to make. Could not say whether they cost half a guinea. This was not a question of four guineas, but whether plaintiffs must stop their instalment plan, and so deprive many of the great benefit of these appliances.

The Defendant said it was represented to him that the belt would do him good. It did not, and he returned it. He hoped the judge would say he had paid enough.

His Honour said defendant filled up the form in the book stating what he was suffering from, and he was sent this belt as being one likely to cure him. He said it did not: but, so far from doing him good, it otherwise affected him. He thought the legal position was that the warranty was that the belt should do him good, and he was entitled to say he would pay so much as it had been no good to him. He (the judge) thought he had paid enough, and he should give him judgment, but without costs.

Mercier's Patent, Limited, *v.* The New Flint Colliery Company, Limited.

This case, which came on at the Manchester Autumn Assizes, was an action to recover the amount of an account for work done.

The case for the plaintiffs was that they carry on business in Collier Street, Salford, and that they entered into arrangements with the defendant company to put into their colliery at Flint an electric light and telephone installation, and provide certain machinery. The defendants had made a payment on account, but they refused to pay the balance, on the ground that the work was not executed efficiently, and that the prices charged were excessive. The amount now claimed was £120.

The jury gave a verdict for the plaintiffs, with £90 damages.

Recording Telegraphs, Limited.

The petition of Messrs. Segrue & Co., Limited, for the compulsory winding-up of the Recording Telegraphs Company, Limited, was again before Mr. Justice Wright in the Companies' Winding-Up Court on Wednesday.

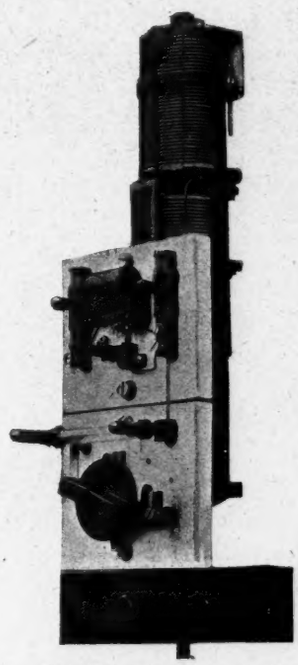
Counsel said it was a creditor's petition, and it had stood over from time to time with a view of amending the petition. There had been a voluntary liquidation, and it had been agreed that they should take a supervision order.

Mr. Ashton Cross, for the company, assented, and also to a committee of inspection composed of two creditors and one shareholder. He said the assets of the company consisted largely of shares, and if they were realised there might be something for the shareholders.

His Lordship granted the supervision order asked for, and said it would be best to limit the powers of the committee of inspection to the dealings in connection with the realisation of the assets of the company.

ARC LAMP NOVELTIES.

We recently had the pleasure of visiting the Gilbert Arc Lamp Company's works at Chingford, and examining the apparatus produced therein. The *pièce de résistance* is, of course, the arc lamp,



Complete "End-post" gear, fixed by two bolts through teak block.

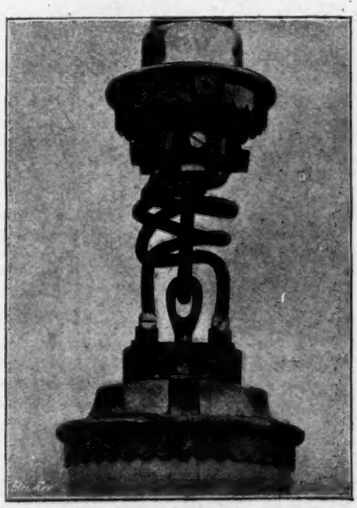
Fig. 1.

50—80 hour lamp; four 18-inch carbons

Fig. 2.

with its various modifications: but the company's operations include a variety of other work, such as transformers for constant current and constant pressure, choke coils, switch gear, &c.

The principal features of the lamp are its substantial construction and simplicity. Unlike the great majority of modern arc lamps,



Weatherproof hood with covers removed.

Fig. 3.

it is a clutch lamp, but is essentially of the focussing type; one might have supposed that almost every possible form of clutch had already been made use of by arc lamp inventors, but Messrs. Gilbert

have evolved a form of clutch unlike any we have ever previously met with. Success has only been attained by inexhaustible patience and experiment, together with many years' experience both in the making and using of arc lamps, and the mechanism of the present lamp has been 12 years in perfecting.

The clutch, however, is by no means the only interesting feature of the lamp; the upper carbon rod is entirely dispensed with; the lower rod is of rectangular section, and slides freely in a single long guide; there is a false bottom to the lamp, with a free circulation of air between the real and the false, to keep the mechanism cool. The carbon holders are very simple, and self-centring.

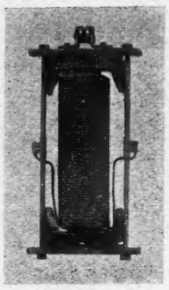
The general appearance of the mechanism is shown in one of our views, fig. 7—which, by the way, represents a double-carbon open arc

Enclosed A. C. lamp, complete with transformer to run off 200 volts.

FIG. 4.

Lamp-post transformer for single arcs, about 8 ins. × 7 ins. diam.

FIG. 5.



Choke coil.

FIG. 6.

lamp, carrying 6 feet of carbon, and burning 50 to 80 hours, according to the current density in the carbons, although it is of ordinary dimensions and practicability. The backbone of the single lamp consists of a stout brass tube carrying a pulley at the upper end, and the double base at the lower end. A flat copper cord running over the pulley connects the upper carbon holder, a split mass of metal, weighing about 2 lbs., with the top end of the lower rod. The upper holder swings freely inside the tube, the carbon being steadied by a guide hole in the lower base close to the arc. In trimming, both the carbons are rapidly clamped, lining up almost automatically; the operation, as we proved, being quite easy, even when the carbons are 18 inches long. The controlling gear consists of double solenoids supported by the central tube, and acting on **U**-shaped cores; these are connected with a rocking beam pivoted on the central tube, and operating the clutch. The piston of the dash-pot is connected directly with the iron core, so that no strain comes on the pivots. There is no other mechanism. For parallel working a series-wound double solenoid suffices; for series working on moderate pressures (up to 500 volts), a shunt-wound double solenoid is used. For series working on high pressures a single series-wound solenoid is added, which, however, lifts its core off the end of the rocking beam, and holds it up out of the way while the lamp is burning, its sole function being to release the clutch and allow the carbons to run together when the current is not flowing. The current with these lamps can be varied at will.

By substituting the **U**-shaped core for the ordinary straight core, and two short solenoids for the single long one, the makers have found it possible to exert a much larger controlling force with a smaller expenditure of power, and much less copper; at the same time a powerful strike and retrace have been obtained. The last mentioned feature is of considerable importance; the full retrace is obtained with a current only 15 per cent. above the normal, and in a few seconds from striking the starting current is within that value. This point we verified with an Evershed ammeter, on a circuit of six 10-ampere arcs in series.

The clutch in this lamp necessarily acts downwards; it consists mainly of a flat frame, which is supported from the rocking beam by a single link at one end. The frame turns freely on a pivot screwed into the link, and is pressed upwards by a small flat spring, fixed to the link in such a way that when the clutch is depressed in striking the arc the grip on the rod is greater, while, when approaching the feeding point, the tension of the spring is relaxed. The grips consist of a serrated edge and a flat self-adjusting brass button; these grip the flat sides of the carbon rod so long as the clutch frame is horizontal, but release it when the frame is tilted by an adjustable stop. The feed takes place by imperceptible degrees, producing no appreciable change in either the current or the light. As there is only one carbon rod, obviously there is only one rod to clean, and there is only one fitted guide, so that the possibility of sticking is remote; moreover, current is led by flexibles direct to the carbon holders, so that the rod cannot be pitted by sparking.

The absence of a top rod enables a much greater length of carbon to be used than is usual, while, nevertheless, the lamp over all is shorter; even the lamp to which we have already referred, containing six feet of carbon, is shorter than most ordinary patterns.

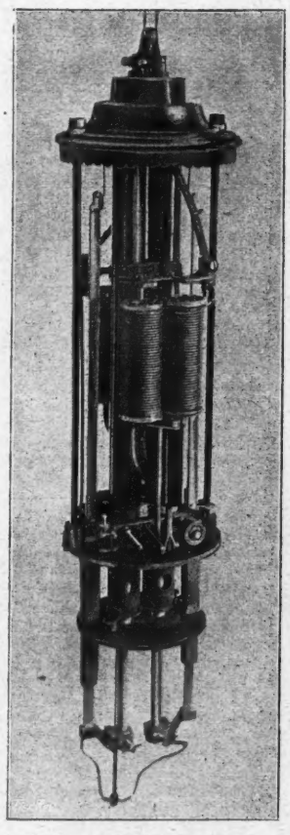
While no pains have been spared to perfect every detail of the lamp proper, the external arrangements have not been neglected. The cover is of artistic proportions, and the globes of new and graceful shapes; in some cases the latter are split, a novel device, rendering the carbons readily accessible. Fig. 3 is a separate view of the hood for attachment to a post; the conductors inside the post are securely clamped, and the central hook is rigidly fixed in an insulator. The hood is made in two parts, telescoping, so that the lamp can readily be hooked up and the connections afterwards made with the leads coiled in a loose spiral; the hood is then adjusted, as in fig. 2, and the result is a weatherproof, ventilated, and flexible connection of small dimensions. There is no chance of the leads working and becoming damaged inside the post.

Figs. 4 and 8 show alternate current lamps complete with transformers, ready for coupling up direct to a 200-volt circuit. These transformers are made by the firm, and are so devised with a definite rate of magnetic leakage as to need no separate choking coil, while they are well ventilated inside. By leaving projecting loops in the secondary winding, it is easy to adjust the ratio of transformation to suit local conditions. The transformer which we illustrate in fig. 5, minus its cover, is of a type intended for inclusion in the base of a post.

A complete set of switch gear is also standardised by the company; this is shown in fig. 1. It consists of a strong short-circuiting switch, a neat fuse, an automatic cut-out, and two extremely simple disconnecting switches, all carried on porcelain slabs, and mounted with the regulating and compensating resistances, also on porcelain, on a teak block, which is bolted inside the post. The whole is very simple, compact, and inexpensive.

The whole of the arc lamps on the Blackpool Esplanade were replaced by double carbon lamps about two years ago, working in series, with rectified currents; the current can be altered at midnight from 12 to 6 amperes, without affecting the working of the lamps, and neither the heavy gales nor the vibrations of the trolley poles upon which they are mounted appear to affect them.

A neat little choking coil of a modified "Hedgehog" type is the subject of fig. 6; in this case also, as in the transformer, projecting loops of wire are left in the outer layer, to provide the necessary adjustment.

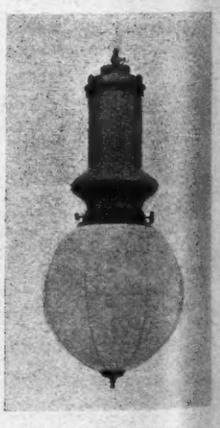


Mechanism of 50–80 hour double carbon lamp.

FIG. 7.

A. C. lamp, with transformer for any voltage.

FIG. 8.



Ordinary form of lamp, for two 12-inch carbons.

FIG. 9.

Besides open arc lamps for direct, rectified, and alternating currents, Messrs. Gilbert have devised enclosed lamps for D.C. and A.C. with great success. A peculiarity in these, and their A.C. lamps generally, is the avoidance, as far as possible, of cored carbons, which, they say, are the chief cause of dirty globes. Two cored

carbons are never used in their lamps; sometimes not even one. By this means "blueness" of the light is minimised, and the efficiency of the lamp increased. They have, in fact, by a simple device, found it possible to burn enclosed alternating arcs with two solid carbons quite steadily, without fear of pumping such as usually occurs under these conditions. Also, the clutch has been shown to be effective on circuits with a frequency as low as 25 ~ per second.

Amongst other installations, a large number of series alternating lamps have been installed at Harrogate.

Other novelties which we saw were a neat automatic cut-out for A.C., to protect the shunt coil, a trigger being released by the blowing of a fuse, and cutting the lamp out of circuit; a simple compensator for two lamps in series off 100 volts A.C., each lamp being practically independent of the other, and taking 45 volts; a simple rectifier with large air-gaps and other special features, &c.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Nov. 21st, 1899.		Week ending Nov. 20th, 1900.	
Adelaide	£42	Amsterdam	£197
Alexandria	709	Auckland	321
Amsterdam	442	Bombay	388
„ Teleg. mat.	45	„ Teleg. wire	301
„ Telephones	50	Buenos Ayres	72
Antwerp. Elec. fuses	302	„ Teleg. mat.	690
Barcelona. Teleg. cable	117	Calcutta	615
Bombay	271	Cape Town	381
„ Teleg. wire	29	Christchurch	37
Brisbane. Teleg. wire	25	Constantinople	162
Buenos Ayres	225	„ Teleg. wire	88
„ Teleg. mat.	135	Durban	244
Calcutta	122	East London	134
Cape Town	810	Genoa	40
Colombo	214	Gibraltar	29
„ Teleg. apparatus	58	Halifax. Teleg. cable	7 877
Copenhagen	26	Hamburg	18
„ Teleg. wire	294	„ Teleg. mat.	400
Demerara. Telephones	30	Hiogo. Teleg. cables	688
Durban. Teleg. mat.	1,5 5	Lyttleton	270
East London	263	Mauritius	68
„ Elec. tramcars	472	Melbourne	935
Gibraltar	173	Ostend	1,251
Gothenburg	67	Otago	182
„ Teleg. wire	19	Port Chalmers	15
Halifax. Teleg. cable	49,000	Port Elizabeth	236
Hamburg	10	Rio Janeiro	30
„ Teleg. mat.	230	„ Teleg. mat.	1,147
Hong Kong	188	Singapore	62
Malta	96	Sydney	675
„ Teleg. mat.	566	Trinidad	7
Melbourne	10	Valparaiso	78
„ Teleg. mat.	110	Wellington	125
Nelson	26	Yokohama	1,639
Ostend	62	„ Teleg. cables	8,835
Otago	22		
Perth	65		
Port Elizabeth	114		
Rio Janeiro. Teleg. mat.	775		
Santos	310		
„ Teleg. mat.	70		
Shanghai	37		
Singapore. Teleg. mat.	60		
Stockholm. Teleg. mat.	136		
Sydney	317		
Wellington	67		
Total	£58,914	Total	£28,221

Foreign Goods Transhipped.

Toronto. Teleph mat.	Value £49	Barbadoes. Teleph. appar.	Value £30

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held on the 15th inst., Thomas William Greaves and William George Randall, lately trading as T. W. Greaves and Co., electrical engineers, &c., at 230, East India Dock Road, and 6, Nelson Street, Greenwich, attended for public examination upon accounts showing liabilities £562 9s. 10d., and assets £15 11s. 9d. The debtor Greaves stated that having previously been employed as an electrician, he commenced business on his own account in March, 1895, with a small capital, at 19, Kirby Street, Poplar. Two years later he removed to 230, East India Dock Road, where he traded as an electrical engineer and cycle manufacturer. Shortly afterwards he was joined by a partner with £150 capital, but the latter retired in June, 1898. Then in January, 1899, witness, at a considerable outlay, acquired other premises at 6, Nelson Street, Greenwich, where, as well as at East India Dock Road, the business had since been carried on. In December, 1899, Mr. Randall became a partner in the business, which, after allowing for £125 capital, brought in by him, was then insolvent to the extent of £300. A deed of dissolution of partnership was executed last February, under which witness agreed to assign his interest in the business to Randall, and to take over the liabilities existing prior to the partnership, he himself receiving a sum of £40, and remaining as manager at Greenwich. The dissolution, however, was not gazetted, nor were the creditors of the firm officially notified, and having regard to a decision recently given in legal proceedings instituted against them, the deed was considered as inoperative. Their failure was caused partly by losses sustained in connection with the business premises and on contracts, but more directly to sudden falling off in trade, to stoppage of credit consequent on an injurious report, and to extreme pressure by creditors, and resulting legal expenses. He knew a year ago that he was insolvent, but did not then consult his creditors because he hoped, by continuing, to recover a sound position and build up a successful business. The debtor Randall was also questioned, and admitted that he had recently defended a creditor's action, and one of the pleas put forward was that of infancy. The examination of both debtors was ordered to be concluded.

Notice is given of release of trustee (Mr. J. Bowling) in *re* Frederick Metcalfe, electrical engineer, of Leeds.

Dissolutions and Liquidations.—A meeting of Nalder Bros. & Co. (in liquidation) will be held on December 20th, at 101, Southwark Street, S.E., to hear an account of the winding up from Mr. F. B. O. Hawes, the liquidator.

A meeting of Cuttriss, Wallis & Co., Limited (in liquidation) will be held on December 19th, at Leeds, to hear an account of the winding up from the liquidator.

Catalogues and Lists.—Messrs. Holden & Brooke's "three best steam traps," each for a special service, are shown on a postal card, which they are now circulating among the trade.

The Birmingham Electrical Fittings Company have issued a postcard which can hardly claim to be the usual size, being about 12 inches by 9 inches, giving illustrations, prices, &c., of their standard "Clip type" distribution board, 1900 pattern terminal type ditto, and special high voltage ditto.

Lists and detailed drawings of the Sinclair No. 1 patent high pressure steam boiler and patent superheaters have come to hand from Mr. George Sinclair, of Albion Boiler Works, Leith. The superheater list gives some details of tests made by Prof. Kennedy, 4½ years ago at the Edinburgh electricity works, where the Sinclair superheater is employed. The sectional coloured drawings illustrate its application (1) to Lancashire boilers, (2) erected on the top of main flue, (3) suitable for a range of boilers ditto, (4) to a dry-backed marine boiler (as at Edinburgh), (5) in the smoke box of a marine boiler.

A batch of small leaflet catalogues has reached us from the General Incandescent Arc Light Company, of First Avenue, New York. Their G.I. incandescent lamps, electric-controlling devices, tailleur junction and coupling boxes, Paragon fan motors, bi-polar motors (from $\frac{1}{10}$ to 1½ H.P.), automatic magnetic circuit breakers, Wright discount meters, G.I. radial voltmeters and ammeters, push button switches, enclosed arc lamps (of several types), and Bergmann lamps are all described. A couple of leaflets give instructions for finding and correcting troubles in enclosed arc lamps, and for connecting, adjusting, and operating L 3 lamps for D.C. multiple series work. The lists are fully illustrated.

From Mr. J. P. Phibbs, who is the representative in Great Britain (Wool Exchange, E.C.), of the Société Anonyme des Ateliers Carels Frères à Gand (Belgique), we have received a well illustrated pamphlet of the engines (Sulzer system), which are manufactured by that company. These engines were mentioned in our "Correspondence" columns last week.

Messrs. Mather & Platt, Limited, of Salford, have just issued a pamphlet describing their electrically-driven pump, which is considered to be a distinct departure from the ordinary electrical pumps in that its output is varied by regulating the stroke of the plungers, which arrangement permits the speed of the motors to remain constant. It is frequently the case that with motor-driven feed pumps resistances are employed to alter the motor speed, and in that way alter the pump output so as to obtain a required variation in the discharge of water. This method of necessity absorbs a large amount of power, and thus reduces the efficiency of the combination. Messrs. Mather & Platt's special type of pump allows, as mentioned, for the stroke of the plungers to be readily varied by hand while the machine is running. The pump consists of three cylinders mounted radially on a frame at angles of 120° with each other, the plungers being driven from a common crank-pin by connecting rods in the ordinary manner. The crank-pin is arranged eccentrically on a disc fitting into a recess in a toothed wheel, which engages with a pinion on the motor shaft. The rotation of this disc, which causes the desired alteration of the stroke, is obtained by gears situate in the hub of the wheel, and operated by a suitable hand lever conveniently arranged. An indicator is fixed to the stroke varying attachment, which shows the length of stroke, and therefore the corresponding output of the pump at the time. To change the stroke, all that is required is to raise the hand lever until the indicator shows that the desired amount of water is being discharged, whereupon the lever is released. The lever can be operated directly in the manner described, or from a distance by suitable connections, and in the latter case is particularly adapted for use with hydraulic accumulators, when it can be readily attached to and controlled by the ram. The main frame work, cylinders and valve boxes are of cast-iron, and the plungers, bushes, and glands of gun-metal; the mild steel connecting rods drive the plungers through the medium of ball and socket joints, which are readily adjustable. The gland flanges are not rigidly attached to the bodies, but are designed to accommodate themselves in case of the gland nuts being tightened unequally, thus preventing undue friction on the plungers. One of the principal features is the arrangement of the valve boxes, which are easily removable, and in which the valves themselves are readily accessible. The motor is of the firm's enclosed steel-clad type, in which the windings are entirely protected from injury; the openings in the end plates can be covered with gauze if desired, and this, while not interfering with the ventilation, permits of the motor and pump being used in coal mines and other places where protection against fire is of the first importance. The list before us gives details of weights, dimensions, &c., of three standard sizes.

The B.T.H. Co.'s list, No. 79, describes the Thomson astatic instruments for continuous current switchboards.

Messrs. Glenfield & Kennedy, Limited, of Kilmarnock, have sent

us a circular relating to "Ashley's patent pump," which is made by them for use in wells, boreholes, &c. There is no bottom valve used in the pump, and a single bucket, in which are mounted both the suction and delivery valves, is the only working part. This bucket reciprocates in the ordinary way up and down in the working barrel; thus when the bucket is lifted out of the rising main for examination or repair, no inaccessible working part is left behind. The makers therefore claim that the pump is provided with perfect accessibility to, and improved arrangements of, the working parts. The other claim set up is that it is quicker running, and sketches are shown to explain that any desired area whatever can be given to the suction valves by merely adding to their number. When required the pump can be constructed to work double-acting, *i.e.*, with a plunger attached, thus forming a bucket and plunger pump. Although the pump has not, we understand, been long upon the market, a considerable number have already been made for bore holes and wells from 6 inches to 20½ inches in diameter.

Cults.—Sheriff Burnet, Aberdeen, has issued an interlocutor in the action in which the trustees of the late Mr John Cameron, contractor, sought to interdict P. C. Middleton & Co., Ltd., electrical engineers, from so working their engines in the electric station at Cults (a suburb of Aberdeen) as to cause annoyance to the neighbouring feuars. His Lordship finds that the noise of the working of the engines is such as to cause pursuers material discomfort and annoyance, and that the noise tends materially to diminish, and has diminished, the value of their properties. He thinks the pursuers are, therefore, entitled to decree sought. As, however, the defenders desired an opportunity of considering the possible adoption of remedial measures, his Lordship delays pronouncing interdict in order to give them such opportunity. He also grants leave to appeal.

High Voltage Keyholder.—We have received from the International Electric Company particulars of their new high voltage keyholder, the main features of which are high insulation, as the switching movement is entirely enclosed by the china body,

impossibility of arcing, and that switching on and off is done in one direction only. When the handle is turned to the left, the switch remains inoperative. The size of the holder is not larger than that of a low voltage keyholder. The accompanying figures serve to show the general appearance of the device.

Fire.—A fire occurred at Doulton's pottery factory at Burslem, on Monday night, doing considerable damage.

Fire Prevention.—At the forthcoming Building Trades' Exhibition there will be a special section devoted solely to fire-resisting materials, methods of construction and appliances. This section, which will form the first collective exhibit of its kind, is to be organised by the executive of the British Fire Prevention Committee, who are anxious to obtain for this trade the importance and recognition of an independent department of building construction. A separate hall has been set aside for the fireproofing exhibits and the space has been very carefully set out, so that there will be the possibility of a thoroughly practical display on the part of the firms interested. A special sub-committee is being formed by Mr. Edwin O. Sachs, the chairman, in conjunction with Mr. Frederick R. Farrow, who presides over the Commercial Section of the British Fire Prevention Committee, and it is proposed to issue invitations to the leading authorities on fire protection, &c., throughout the country to participate by attendance and otherwise in the Exhibition in question. The whole of the business arrangements will be in the hands of Mr. Montgomery, of Essex Street, Strand, the organiser of the Building Trades' Exhibition, but all questions of scientific interest and practical display will be in the hands of the Fire Prevention Committee, with the view of making the Section thoroughly useful to the architectural, surveying and engineering professions, as well as to the local authorities and insurance companies. The Fire Prevention Committee will themselves be exhibiting a model of their testing station, &c.

London County Council.—The following notices of motion were proposed by members at Tuesday's meeting. By Mr. Baker: That, in view of the desirableness of no longer withholding from North and East London the advantages of electric tramway traction, and of the importance of providing a complete and united system of electric tramway intercommunication between the different parts of the metropolis, the Highways Committee be instructed to ascertain from the North Metropolitan Tramways Company at what price they will surrender the lease now held from the Council, which expires in July, 1910. The Council passed this motion. By Mr. Parker: That the General Purposes Committee consider the best manner of bringing before the new Borough Councils the imperative necessity of making subways under, at least, all the leading thoroughfares of the metropolis to contain all the gas and water pipes and telephone and telegraph wires; and, if necessary, to summon a conference to formulate some comprehensive scheme for remedying the scandalous and ever-increasing inconvenience to pedestrian, omnibus, and mercantile traffic caused by the constant tearing up of the footways and roadways for the purpose of inserting or removing the pipes, wires, &c., above referred to.

Smoking Concert.—The first of a series of smoking concerts organised by the Bradford Corporation Electricity Department was held on the 16th inst. at the Queen Hotel, Mr. R. A. Chattock, chief engineer, presiding.

Tramway Track Construction.—Catalogues whose contents are in any way connected with the construction of permanent ways for tramways are calculated to be serviceable to all who are taking part in the electrical equipment of traction systems. This remark is especially applicable to the revised list of Messrs. Askham Bros. & Wilson, Limited, of Sheffield, on account of their very close connection with so many of the electric tramway systems already equipped in this country. At the present moment they have a large number of tramway material contracts executing, and these include the Croydon, Liverpool, Huddersfield, Leeds, Sheffield, Manchester, and Bristol lines, and there are few tramway systems in operation in England which do not include something or other of Messrs. Askham Bros. & Wilson's manufacture, while in connection with the important system of the London United Tramways Company, their points and crossings are used. Some of Messrs. Askham's work has been described in the course of Electrical Review articles on new English trolley systems as they have been opened, but we may briefly outline the contents of the catalogue which is under our immediate notice. Marshall's patent automatic "fixed" and "movable" points can be adapted to any section of tram rail. The movable points are for use on tramway junctions, cross-over roads, and so on, and they contain no complicated parts, ensure an easy run through the points, are readily renewed, do not allow of tongue bending or breaking, nor deal roughly with the springs. They are made in crucible steel, the tongue being forged steel and so fitted that it cannot work loose; at the same time these movable points provide for efficient drainage. Many specimens of special track construction are illustrated in the list. They include compound crossings fitted to movable points, compound three-way crossings, automatic fixed points to suit a Vignoles rail, open points and fixed points to suit a Bull head rail, angle, level, and special junction crossings, loops, cross-overs, and passing places of a variety of descriptions. The special work caried out at the entrances to a number of depôts, or car sheds, are shown in some cases, while photographs of work during construction are given for other towns. At Leeds and Sheffield, this work was somewhat elaborate. The "Stag" brand quality of crucible cast-steel is used for the points and crossings, and it is now pretty well known among English tramway managers and engineers. Marshall's patent joint or sole plates (steel) are fitted with patent lock nuts, and Dawson's patent escape or drain rail is already familiar to our readers; tie bars, car wheels, crucible steel tires, engine and car springs, platelayers' tools, drilling clamps, traversing screw jacks, and a variety of general tools are included in this very timely catalogue.

Trade Announcements.—Messrs. Pyke, Harris & Co., Ltd., of Prince's Mansions, S.W., have been appointed London agents for Messrs. John Gibbs & Son's (of Liverpool) ventilating specialities, including their extremely efficient and well-designed electrically-driven ventilating fan. They have fans on show at their address. The fans are stated to be constructed on scientific principles, and from data arrived at by many years' experience and experiments. In their price lists the actual performances of the fans are given.

The General Electric Company, Limited, have added to their branches in Manchester, Glasgow, Birmingham, Newcastle and Dublin, a further one at East Wharf, St. Mary Street, Cardiff.

ELECTRIC LIGHT AND POWER NOTES.

Bangor.—The capacity of the present station having been fully taken up, the Council intends to provide an additional steam dynamo of 290 kw. at a cost of £2,500, thus doubling the capacity.

Barnsley.—The T.C. has resolved to seek power to borrow £20,000 for additional electric plant.

Blairgowrie.—Owing to the lapse of the time for giving notice of intention to apply for a prov. order, the proposal before the Police Commissioners—to obtain an electric lighting order and lease it to Messrs. Crompton & Co., Limited—has had to be deferred till next year.

Bray.—The new electrical engineer, Mr. Thomas Tomlinson, B.E., who took over the station on 5th inst., recently reported to the U.D.C. that the principal running plant was working over its load, that the reserve plant was not of sufficient capacity, and that the Council should refrain as far as possible from taking on new consumers until the portion of the plant which it has been decided to introduce was in working order. The report was adopted.

Bristol.—The Electrical Committee has resolved to recommend the T.C. to rescind the resolution of February 27th, 1900, relating to the appointment of an architect for the superstructure of the electricity works, in view of the reports of Sir W. H. Preece and Sir Benjamin Baker. It will be remembered that the Council insisted on the appointment of a professional architect; Mr. Alderman Pearson, chairman of the Committee, resigned in consequence of this, but was induced to reconsider the step.

Caledonian Electric Power Company.—The necessary notices have been given for the incorporation of a company with the above name, with powers to generate and distribute electrical energy, both in bulk and generally for power and other purposes, throughout the large and important manufacturing district in the West of Scotland that includes the whole of the county of Renfrew, the industrial portion of the county of Lanarkshire, and portions of the counties of Dumbarton, Stirling and Ayr. The City of Glasgow is excluded from the operations of the proposed scheme, which is upon similar lines to the Lancashire, South Wales and Durham Power Bills of last session. Mr. A. A. Campbell Swinton, M.Inst.C.E., is engineer to the scheme, which has the support of leading manufacturers of the district.

Cheltenham.—The T.C. has resolved to wire small houses for the electric light on the system of repayment spread over a series of years.

Chesham.—The D.C. has resolved to apply for a prov. order for lighting Chesham by electricity, and to engage Mr. Hawtayne to prepare a preliminary scheme, and report to the Council, at a fee of 25 guineas.

Cleveland.—Application will be made in the next session of Parliament for powers to establish an undertaking for the distribution of electric power over the Stockton, Middlesbrough, Cleveland, and West Hartlepool districts.

Crieff.—The T.C. has resolved to apply to the B. of T. for a prov. order to light the town with electricity; it is proposed, on obtaining the order, to lease it to a company.

Cults.—The public lighting by electricity was inaugurated last week, and gave great satisfaction.

Dorking.—The U.D.C. has resolved to transfer its electric lighting prov. order to a company, and has asked certain firms to tender.

Foots Cray.—The Bromley R.D.C. has adopted a resolution to apply for a prov. order authorising the supply of electricity for public and private purposes within the parish of Foots Cray, and within that portion of the parish of Chislehurst known as the Lower Borough in the district of the U.D.C. of Chislehurst.

Guisborough.—The U.D.C. is in negotiation with the Northern Counties Electrical Supply Company with regard to the company's application for a prov. order.

Inverness.—At a meeting of the T.C. last week, Treasurer Ross proposed that the Town Chamberlain be instructed to pay Mr. Craven, the electrical engineer, as already offered and accepted, 2½ per cent. on the estimated cost of the now abandoned electric lighting scheme, with £59 for outlays, being a total of £734 for work after appointment. The motion was carried.

The T.C. has received a letter from the solicitor of the North of Scotland Electric Light and Power Company, renewing his offer of August last to take over the Council's prov. order. The company now offers to pay to the Council the sum of £1,000, and to take over the Council's liabilities to Mr. Craven. The Council is considering the matter.

Lewes.—The Electrical Power Distribution Company has placed a contract for electricity works buildings with Messrs. Field & Co.

Limerick.—A deputation from the Corporation has waited on the L.G.B., with the object of inducing the Board to reconsider its decision with regard to the proposed loan of £22,000 for electric lighting purposes.

Llangollen.—The U.D.C. has resolved to apply to the B. of T. for a prov. order for electric lighting.

London.—Marylebone.—The Borough Council has decided to call a statutory meeting to take the necessary steps to apply for a prov. order to supply electricity in the borough.

London Bridge.—The Bridge House Estates Committee has framed a scheme for widening the bridge, and lighting it with electricity.

Court of Common Council.—Last week the Streets Committee submitted a scheme for the testing of all electric meters for use in the City, under the direction of the electric inspector, at the expense of the City of London Electric Lighting Company and the Charing Cross and Strand Electricity Supply Corporation, the electric lighting undertakers each to refund, in addition to the other expenses, a sum of £200 per annum to the Corporation in respect of the inspector's salary. The committee recommended that Mr. Voysey's salary should be increased from £350 to £500 per annum, of which sum £400 would under the proposed arrangement be refunded to the Corporation. The recommendation of the committee was approved.

Manchester.—The new Electricity Committee has appointed Dr. Bishop as chairman. Dr. Bishop was instrumental in bringing about the recent inquiry into the working of the electricity department.

Mexborough.—A L.G.B. inquiry was held on Tuesday relative to an application by the U.D.C. for power to borrow £18,000 for electric lighting.

Newbury.—Preliminary arrangements are in progress for making an application to the B. of T. for powers to establish electric light works in the town by a London company.

Newport (Mon.).—The Electricity Committee of the Newport Corporation, and the Lighting and Traffic Committee, are to be dissolved, and a new committee formed to deal with electric lighting, power and traction.

Northfleet.—The U.D.C. has decided to apply to the B. of T. for a prov. order for electric lighting.

Ormesby.—The U.D.C. having inquired whether the Middlesbrough Corporation could supply electricity in bulk, was recently informed that the Corporation had not the necessary legal powers to do so.

Penistone.—The Rural Council has received a circular from the Yorkshire Electric Power Syndicate, Limited, setting forth that a scheme was being prepared for the supply of electric energy.

Pocklington.—The U.D.C. is considering the question of electric lighting.

Provisional Orders.—The *London Gazette* for November 16th contained the following notices regarding provisional orders:—Applications to be made by the Felling U.D.C.; Northwood Electric Light and Power Company for powers for lighting Northwood and Ruislip; Wellington (Salop), application by U.D.C.; Ilkley, Middleton, and Denton, application by A. H. Gibbings; Beverley, application by the Corporation; Neath, application by the Corporation; Notting Hill Electric Lighting Company, powers to acquire land and construct generating and transforming stations in Kensington borough; Northfleet, application by U.D.C.; Aberavon, application by Corporation.

Notices regarding the following applications for powers appeared in the *Gazette* on November 20th:—Lyndhurst (Lyndhurst Electric Lighting and Traction Company, Palace Chambers, S.W.); Rhondda, (U.D.C.); East Middlesex (joint board of the Edmonton, Enfield, Southgate, Tottenham, and Wood Green Councils); Ebbw Vale (U.D.C.); Chesham (U.D.C.); Royton (U.D.C.); Ross (John Parker, Hereford); Faversham (Corporation); Abertillery (U.D.C.); Burgess Hill (U.D.C.); Metropolitan Electric Supply Company (extension of powers to Paddington borough, laying new cables from Willesden into London, &c.); Lichfield (Corporation); Teddington (U.D.C.); Widnes (Corporation); Llangollen (U.D.C.).

Rowley Regis.—On Monday, at a meeting of the U.D.C., the General Purposes Committee reported that they had made an investigation of the prov. order obtained in 1898 by the Midland Electric Corporation for Power Distribution, Limited, for the supply of electricity for motive and lighting purposes within the district of the Council. The provisions for purchase by the local authority were not satisfactory, and the Committee recommended that the Council should proceed to obtain a prov. order of their own. It was proposed that the clerk should ascertain the terms of the company, and in the event of these being unfavourable the clerk undertake to apply for an order. This was agreed to.

Sheffield.—In an interesting report of his tour on the Continent Mr. S. E. Fedden, the city electrical engineer, recently laid before his committee his observations, chiefly directed, of course, to the development of alternating current machinery. At the Paris Exhibition, polyphase motors of all sizes were at work for all purposes, but few single-phasers being seen. The Bremer arc lamp, in which carbons containing 20 to 50 per cent. of metallic salts are used, receives favourable notice, but the street arc lighting of Paris is said to be "not very good." At Strassburg Mr. Fedden was interested in a polyphase motor which he found working in the pouring rain, without any sort of cover. The charge for energy for lighting in that city is over 6d. per unit, and for power 2½d. Coal is very expensive, and the works cost comes out at 1·43d., in spite of the very heavy motor day-load. Comparing the direct and alternating current machinery sections of the Schuckert Electrical Company's works at Nuremburg (where 8,000 men are employed)—each of which is driven by motors of its own type—Mr. Fedden found little difference between the adaptability and working of the two systems, though the A.C. motors could put up with rougher usage and less attention than the D.C.

THE AUTOMOBILE TRIP TO SOUTHSEA.

entirely dependent upon water-power for driving the dynamos,

More than half the load of the Nuremburg electricity works consists of single-phase motors, no less than 1,100 H.P. being connected, and the motors ranging from ½ to 50 H.P. These give entire satisfaction, and but little variation of pressure occurs. The price for lighting in Nuremburg is 8d. to 9d., for power 2½d. per unit, and coal costs as much as 1d. per unit.

At Messrs. Brown, Boveri & Co.'s works Mr. Fedden saw a device of peculiar interest to Sheffield manufacturers—the working of power hammers by compressed air, the compressor being driven by a polyphase motor.

Single-phase motors were to the fore again at Frankfurt, 4,000 H.P. out of a total capacity of 9,000 H.P. consisting of such motors. A single-phase motor working an elevator was particularly noteworthy, its working being extremely simple and satisfactory. Another motor was used to automatically maintain water under pressure for working a hydraulic lift.

The Helios Company informed Mr. Fedden that the bulk of their new work is polyphase. It is interesting to note that the two alternating stations at Cologne are unable to run in parallel, on account of the difference in the wave-forms of the alternators used.

The conclusions at which Mr. Fedden arrives are that his scheme for converting the Sheffield single-phase system to polyphase is fully justified, and that the Continental stations are designed on liberal and comprehensive lines, worthy of careful consideration by British engineers.

Selkirk.—The T.C. has resolved to oppose the application by the North British Electricity Supply Company for a prov. order to supply electrical energy within the burgh.

Shannon.—Before the Chancery Division of the High Court of Justice in Dublin on the 13th inst. an application was heard by the Master of the Rolls that the sum of £7,798 in consols, and £153 13s. in cash, the amount of the Parliamentary deposit lodged on behalf of the promoters of the Shannon Electrical Power Bill, 1900, should be transferred to the names of the depositors, one of whom was Baron Rothschild. The Bill successfully passed the House of Commons, but was rejected by the Committee of the House of Lords. The Master of the Rolls granted the application.

Skipton.—The U.D.C. has resolved to apply to the B. of T. for a prov. order for electric lighting.

Smethwick.—The British Electric Traction Company, Limited, have now arranged terms with the Council for the supply of electricity for lighting and power purposes to the borough. The Council insisted upon one uniform charge for electric lighting, and this has been acceded to. Mr. J. G. Aldridge, the expert called in by the Council, has expressed a favourable opinion upon the agreement.

South Shields.—A syndicate has been formed for the purpose of erecting an aerial bridge across the Tyne between North and South Shields; a Bill will be promoted in Parliament next session with a view to seeking the necessary powers. The proposed bridge is to be 200 feet high, with a clear span of 640 feet; it will be erected on the principle of a platform suspended by cables, and will be worked by electricity supplied by the Corporations of Tynemouth and South Shields.

Southend.—At a meeting of the T.C. last week the borough engineer submitted a report on the subject of electric lighting. He advocated a direct current three-wire system with arc lamps for street lighting. The estimated cost of installing the arc lamps would be £1,460, and of the whole undertaking £36,030. The Light Railways and Electric Lighting Committee recommended that the report be adopted and that application be made for borrowing powers for £36,030, besides £4,000 for making provision for such additional cables as might be required for extensions of the lighting area. The report was adopted.

Stroud.—The Gaslight Company is going in for a number of new powers, including provisions to enable the company to apply for powers under the Electric Lighting Acts.

Standish-with-Langtree.—A report on the electric lighting question is being furnished to the Council by Messrs. Lacey, Clirehugh & Sillar.

Thornley.—The village of Thornley has been lighted with 50 electric lamps erected by the Parish Council, who have entered into an arrangement with the Weardale Iron and Coal Company for a supply of current from the colliery.

Tunbridge Wells.—An exhaustive report on the Tunbridge Wells electric light undertaking has been issued by Mr. Horace Boot, the borough electrical engineer, in which he states that during the 12 months under review the total expenditure was £5,170, and the total income £8,493 0s. 5d. Allowing £201 16s. for bad debts, and 3 per cent. each for capital and redemption funds, the profit works out at £764 12s. 10d. To a company the profit available for distribution would be £3,120.

West Ham.—The Board of Guardians has received notice from the L.G.B. that it is prepared to sanction a further expenditure of £1,875 on the electric lighting of the West Ham Union and schools, bringing the total expenditure up to £6,500.

Worthing.—According to the *West Sussex Gazette*, there were no fewer than 106 applicants for the position of resident engineer to the Worthing electric lighting works.

Yorkshire Power Schemes.—Among the Parliamentary Bills of the coming session, says the *Leeds Mercury*, is a measure for the incorporation of the South Yorkshire Electric Power Company, which proposes to establish generating stations, and to supply electricity within an area defined by a line drawn from a point near Bolton Abbey through Doncaster, and by way of Whitley Bridge, Low Egborough, Burn, and Brayton, to Selby, where it turns at the pay-bridge to the mouth of the Wharfe, and thence back to Bolton Bridge.

Another company, which has been registered under the name of the Yorkshire Electric Power Syndicate, Limited, proposes to supply electricity in bulk to local authorities and others throughout the southern or manufacturing portion of the West Riding of the County of York. The portion of the West Riding included in the scheme is that lying south of the Rivers Wharfe and Ouse, and the turnpike road from Bolton Bridge through Elsack and Skipton to Foulridge on the Lancashire boundary. The area is about 1,800 square miles, with a population of about 2¼ millions. It contains 17 municipal and county boroughs, 119 urban districts, and 22 rural districts, including such important industrial centres as Leeds, Bradford, Keighley, Halifax, Todmorden, Brighouse, Huddersfield, Dewsbury, Batley, Morley, Pudsey, Wakefield, Ossett, Barnsley, Sheffield, Rotherham, Doncaster, Pontefract, Goole, &c. The formation capital has been fixed at £10,000, and the whole of this has already been more than offered, though the concern has thus far not been submitted to the public, having been organised solely by a number of large manufacturers and colliery owners, who believe not only that the undertaking will prove a financially sound one, but that some such scheme is of the highest importance both to local authorities and to industrial concerns generally. Mr. Arthur Greenhow Lupton, of Leeds, is chairman of the directors, and has as colleagues on the board Mr. Robt. Armitage, Brown-Bailey Steelworks, Sheffield; Mr. A. Currer Briggs, Whitwood Collieries, Normanton; Mr. Joseph Crowther, Marsden Mill Company, Huddersfield; Mr. Robt. Hudson, Gildersome Foundry, Leeds; Mr. Charles Letch Mason, The Hollies, Leeds; and Mr. F. Priestman, Messrs. J. Priestman & Co., Bradford.

Of the 158 authorities mentioned, there are at present only 11 having works established and supplying electricity, some of them on only a very small scale, and none on a scale sufficient to attempt general power supply. Three have works in progress, while in 18 other cases, though provisional orders have been, or are being secured, no further steps have been taken towards carrying out the powers thus obtained.

Power will be supplied from four main generating stations, each serving an area some 16 miles in diameter. Though not yet definitely decided upon, these will probably be located in the vicinity of Rotherham, Methley, and Mirfield in the colliery area, and at Bingley in the manufacturing area.

The proposed minimum capital of the Parliamentary Company is £3,000,000, with power to issue debentures for a further £1,000,000, this being the same as in the Lancashire scheme. The syndicate have secured the services of Mr. A. H. Gibbings, late electrical engineer to the city of Bradford, and Messrs. W. T. Pressland and John Sturgeon, who promoted the Lancashire scheme, Mr. Sturgeon having also had experience in connection with the Niagara power works.

ELECTRIC TRACTION NOTES.

Beckenham.—At a meeting of the U.D.C. last week letters were read relating to a proposal to establish a light railway between Beckenham, Penge, the Crystal Palace, and Croydon, and a tramway between Penge, Beckenham, and Bromley Common. The matter was referred to the Works Committee.

Berlin.—The *Morning Post* Berlin correspondent states that the introduction of electric tramways on a large scale in Berlin has not been effected without an attendant loss of life. "According to an official report just issued, 28 people were killed and 82 people severely wounded in the months of July, August and September in consequence of tramway accidents. This, as the Municipal Council has remarked, exceeds the German list of casualties in China. It is widely complained that the electric tramway companies entrust to the control of inadequately trained drivers and conductors those enormously heavy accumulator wagons, the continual rumbling of which now imparts its characteristic sound to Berlin street life. These wagons are extremely difficult to manage, and scarcely a day elapses without a collision in some quarter of the town. The company assert that the many casualties are chiefly due to the carelessness of the public—an excuse which has given rise to much ironic laughter in the Berlin Municipal Council. Unfortunately, the President of the Police appears to resent the interference of the Council in a matter which he regards as his own prerogative. The Council, however, has now besought the magistracy—note the circumlocution of a municipal system which has to divide its functions with the State police—to petition the President of Police to adopt remedial measures with the utmost expedition."

The writer of the above dispatch, while mentioning that the battery cars are the chief cause of the accidents referred to, omits to refer to the announcement which was recently made regarding the proposal to abandon accumulators and employ the overhead trolley in their place.

Clydebank.—The Commissioners intend to apply to the Secretary for Scotland for a provisional order for the construction of tramways, and to the Board of Trade for a provisional order to supply electric lighting.

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THE AUTOMOBILE TRIP TO SOUTHSEA.

Last week we mentioned that in the Automobile Club's run from London to Southsea and back, the Harmsworth silver cup was gained by Mr. H. Edmunds's Daimler car. Mr. Edmunds, as the principal partner in W. T. Glover & Co., and as a Member of the Council of the Institution of Electrical Engineers, is thoroughly well known to all in the electrical profession and trade, and we have thought that our readers would be interested in seeing a photograph of the car, although it is not an electrical one.

Mr. Edmunds's "Antrona."

Mr. Edmunds ran two cars down to Southsea, and No. 78, which we illustrate standing before the Town Hall, Portsmouth, was awarded the cup on account of its smart appearance at the conclusion of the journey from London. Both of the cars were 6-h.p. Daimlers, but the "Antrona," which had on board Mr. and Mrs. Edmunds, the Mayor (Mr. Alderman Emanuel), and Mrs. Staplee Frith, was successful.

ELECTRICITY AT ARDROSS CASTLE.

A private installation of unusual interest has recently been completed at Ardross Castle, in Ross-shire, some 30 miles north of Inverness. The whole work has been carried out to the designs and under the supervision of Mr. Walter P. Adams, M.I.E.E., of London.

Special points of interest are that the installation is entirely dependent upon water-power for driving the dynamos, and that large use has been made of electricity for heating purposes. As the lamps, motors, heating apparatus, &c., are in all equivalent to some 3,000 8-c.p. lamps, the installation is of the magnitude of a small town undertaking.

The water supply is taken from the Tollie Burn, which runs behind the Castle, about a quarter of a mile distant. The stream is quite a small mountain torrent, the total collecting area available being only about two square miles. It rises in a range of mountains with unpronounceable Gaelic names—as, for instance, Cnoc an t-Sithein Môr and Doire Leathann—and is fed by numerous springs which ensure a good flow even in the driest summer weather. From observations taken over the past two years, it is calculated that the water supply is sufficient for a plant of double the capacity of that now in use.

The Tollie Burn is tapped about 1½ miles above the Castle, and the water is carried in a lade through a fir plantation to a small lake, which, being artificial, generally goes by the euphonious name of "The Dam." This lake is of sufficient capacity to supply the installation in summer for three weeks without inflow, and it also supplies the Castle with water; in fact, it was originally constructed for this purpose some 40 years ago.

From the Dam a pipe line has been constructed to the turbine house, which stands on the bank of the Alness River, over 3,000 feet distant. The pipes are 10 inches inside diameter, cast-iron socket and spigot, and are buried in a trench

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Bills of the coming session, says the *Leeds Mercury*, is a measure for the incorporation of the South Yorkshire Electric Power Company,

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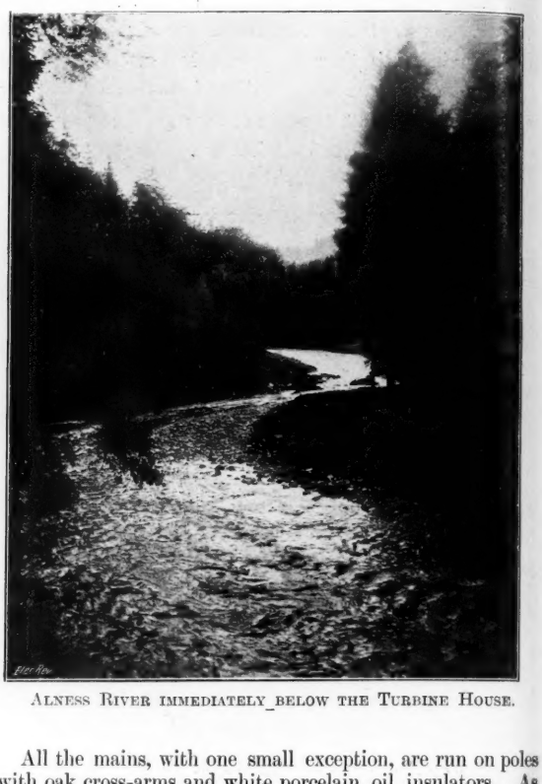
about 3 feet deep. The total fall from the Dam to the tail race is 285 feet. Provision has been made at both ends for a second line of pipes.

The turbine house is a simple four-walled building standing 20 feet above the river, with room for two more generating sets similar to those already installed. The tail water is taken straight down in cast-iron suction pipes into a large pit, from whence it is discharged through 20-inch earthenware pipes into the river.

Two exactly similar sets of turbines and dynamos are in use, one being sufficient for all ordinary requirements. The turbines are of Gilbert Gilkes & Co.'s well-known Vortex type, giving 25 B.H.P. each at 1,200 revolutions per minute. They are provided with centrifugal governors, regulating by hydraulic means the admission of water to the wheels by opening and closing the guide blades. After being in use for some months, these governors began to give trouble, and upon examination, it was found that the small inlets to the hydraulic cylinders and valves were getting choked with an impalpable peaty deposit; this difficulty has been met by fixing a special pressure water filter, through which all water used for the governors and valves has to pass. It is remarkable that the deposit finds its way to the turbines, as the inflow and outflow of the dam are at extremes of the basin, about one-sixth of a mile apart, and there appears to be an ample settling ground for all such deposit.

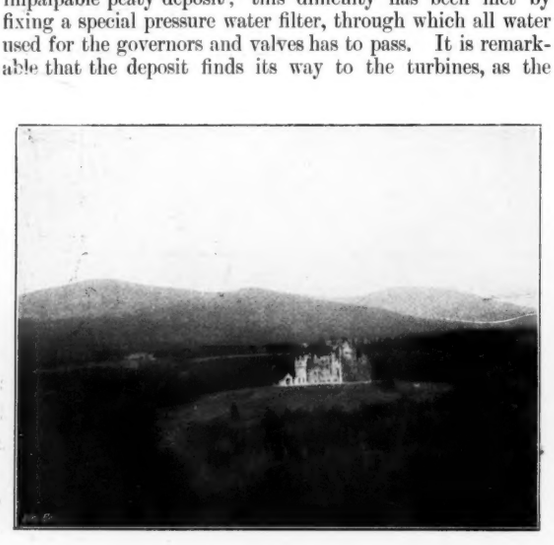
The Turbine House.

The dynamos are coupled direct to the turbines, and therefore run at 1,200 revolutions per minute; they have an output of 80 amperes each at 220 volts. They are overcompounded, so that at no load 200 volts is obtained, and at full load 220 volts. They are provided with carbon brushes, and the oiling arrangements are designed for continuous running. The necessity for continuous oiling arrangements will be realised when it is understood that the plant is required to run all night without attention. For several reasons it was not thought desirable to employ accumulators on the installation, and so the plant has to be kept running night and day, with only occasional stops during the day: it has been in use for over a year, and has fulfilled these requirements admirably.

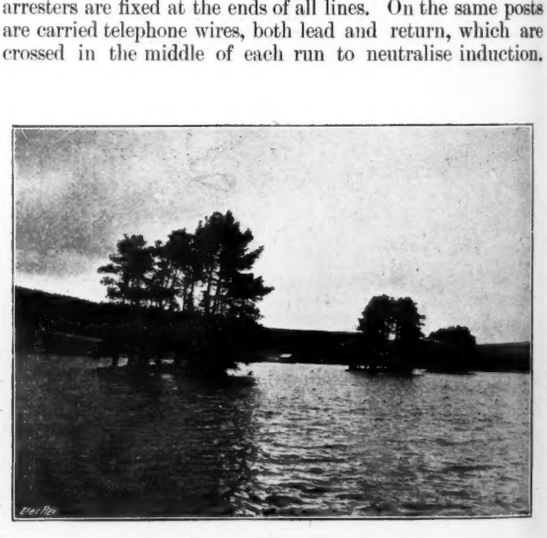


Alness River immediately below the Turbine House.

All the mains, with one small exception, are run on poles with oak cross-arms and white porcelain oil insulators. As a protection from lightning, barbed steel wire is carried on the top of the poles and earthed. Magnetic lightning arresters are fixed at the ends of all lines. On the same posts are carried telephone wires, both lead and return, which are crossed in the middle of each run to neutralise induction.



Ardross Castle.



Small Loch from which Water Supply is taken.

An insulated return is necessary, as the negative electric light leads are earthed throughout the installation.

Nearly the whole of the overhead wires are carried through plantations of fir and hard wood, and so are not conspicuous. A short length of underground cable is used in the neighbourhood of the new Church for crossing the road.

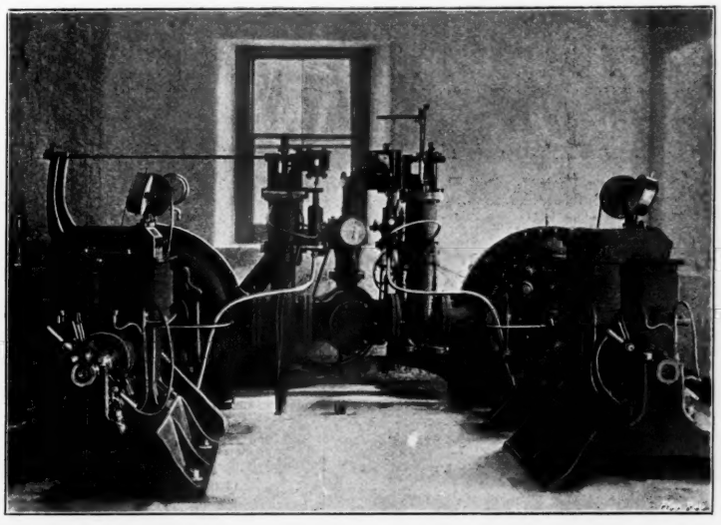
From the turbine house to the Castle two pairs of 19/16 bare copper cable are run on oil insulators. The poles for the overhead construction were provided on the estate, which abounds in beautiful fir plantations. From the Castle a pair

of overhead mains, of 19/16 bare copper, are run to the estate farm and workshops, and some distance from the Castle a branch from these, also of 19/16 cables, is carried to the Church, 700 yards away. A smaller pair of mains is run from the Castle to the stables, 200 yards distant. It will thus be seen that the two sets of mains between the turbine house and Castle are feeders, and the pressure is maintained at 200 volts at the Castle. Altogether 1½ miles of feeders and distributors have been run.

Before referring to the switchboard and automatic appliances, it will be necessary to give a general description of the installation.

Sluice and Pen-trough at the Head of the Pipe-line.

In the Castle some 350 lights have been installed, and the wiring throughout has been done on Mavor & Coulson's concentric system; the distribution boards, however, have been made specially, and have switches and cut-outs fitted for every circuit, mounted on enamelled slate bases and enclosed in polished teak cases with glass fronts. The two feeders are brought to two main distribution boards in the kitchen corridor, and from these, circuits are run to nine sub-distribution boards. A voltmeter and recording ammeter are fixed near the main boards, and also an automatic alarm, which rings loudly if either one or both of the dynamos are overloaded. The necessity for this will be seen when it is stated that the total current taken by the lamps and radiators is 240 amperes, and the total capacity of the dynamos is 160 amperes. It only comes into use occasionally, but is, nevertheless, very necessary. The bell rings at 90 or 180 amperes, thus allowing a small overload with one or both machines.



Generating Sets.

The general lighting of the Castle calls for little special comment; but the whole installation provides a most striking instance of the immense improvement that the introduction of electric lighting makes in a country house. Before electricity was installed, the lighting was done with oil-gas and oil lamps, and the large rooms with dark ceilings were very gloomy and depressing at night; the present lighting is a most striking improvement.

The lighting of the ball-room and dining-room is noteworthy. The ball-room is of noble dimensions, and very like that at Balmoral; it is said to have cost some £30,000. Three 12-light fittings are suspended from the roof, and down the sides 10 three-light pendants are hung from the hammer-beams, the effect being brilliant and most pleasing.

All these fittings were specially designed by Perry & Co., and are made in oxidised brass. An electric piano is used in the ball-room, which created quite a sensation amongst the local people when first introduced. It is certainly uncanny to see the piano playing by itself with the keys rising and falling as if operated by invisible hands.

The lighting of the dining-room is a great contrast to that of the ball-room, in that the fittings are of a very simple character. The ceiling, however, is very elaborate and massive, and any fittings sufficiently bulky to attract notice would have been out of place; 18 lamps have, therefore, been spaced in the mouldings, and a general distribution of the light has been produced with excellent effect.

The installation at the Castle is rendered unique by the large use which has been made of electricity for heating. Some 26 bedrooms, as well as sitting, linen, and brushing rooms, are fitted with electric radiators; these have proved to be most valuable in the saving of labour in cleaning fire-places, and in the carrying of coals; the saving of coal, also, is considerable, as its ordinary cost delivered at Ardross is in the neighbourhood of 30s. per ton.

The rooms heated vary in size, and the radiators have been wound accordingly, the current taken varying from 3 amperes to 12. The larger are provided with three switches, by which ¼, ½, ¾, and full heat can be obtained; they are of Crompton & Co.'s make, and the greater part were made to a new pattern at the desire of Mr. Adams. Two of these can be seen in the switchboard photograph, and it will be noticed that the ugly studded plate has been replaced with one of an ornamental design. Though heavy, these radiators can be very easily handled; the old "47A" screen radiator made by Crompton and Co., was the only screen radiator of similar proportions made by this firm until the introduction of the Ardross type described above. All the heating apparatus in the Castle is fed from safety disc wall sockets, the only kind regarded by the engineer as safe at 200 volts, for the large currents taken.

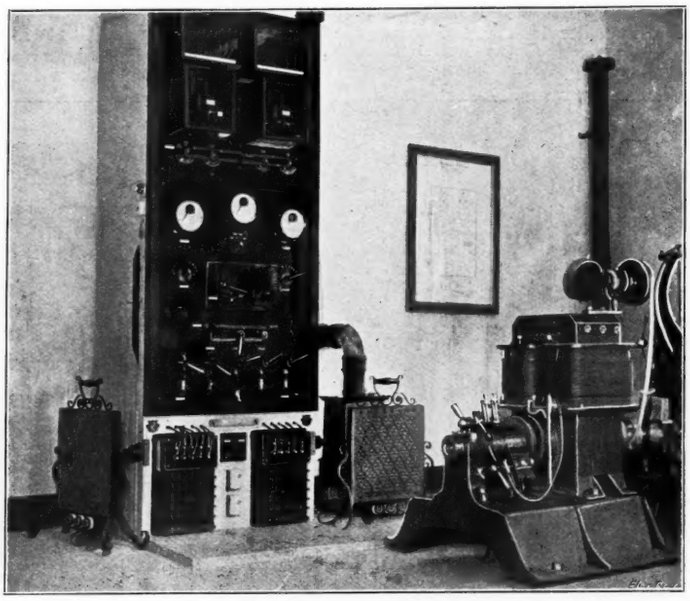
In addition to the radiators, a large cupboard, outside the dining room, is heated electrically, and a waterheater has been fitted into the hot water supply system.

The installation at the stables and laundries calls for no special note, except perhaps that provision has been made in the coach house for charging an electric motor car.

realised when it is understood that the plant is required to

abounds in beautiful fir plantations. From the Castle a pair

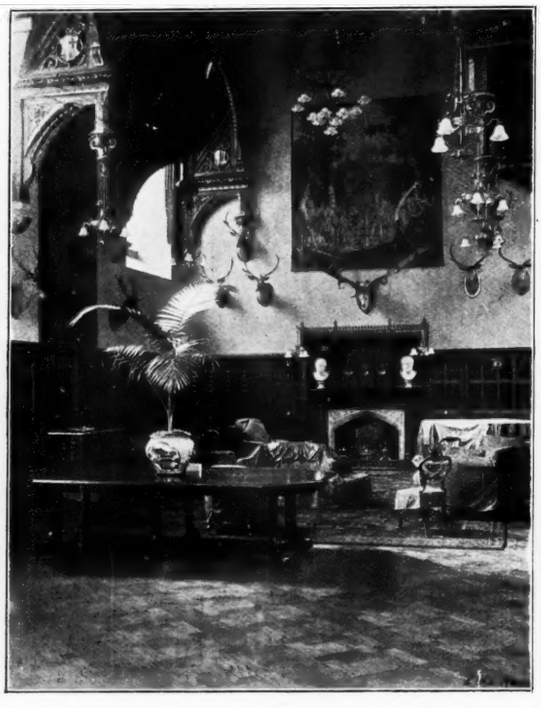
At the farm a 15-B.H.P. motor has been installed for driving the farm and estate machinery; this comprises a thrashing machine, chaff and root cutters, oatcake crusher, straw blower and elevator, winnowing machine, &c., a large circular saw, and a quantity of wood-working machinery. A very heavy fly-wheel has been fitted for use with the saw, but notwithstanding this, it has been found necessary to provide an alarm bell, which rings automatically near the sawyer when he is feeding too fast. The starting switch is provided with slow worm gearing and handwheel to prevent the load being put on or taken off too fast for the turbine, as the hydraulic governors of necessity cannot cope with sudden large alterations. Some of the shops at the Farm are lighted electrically.



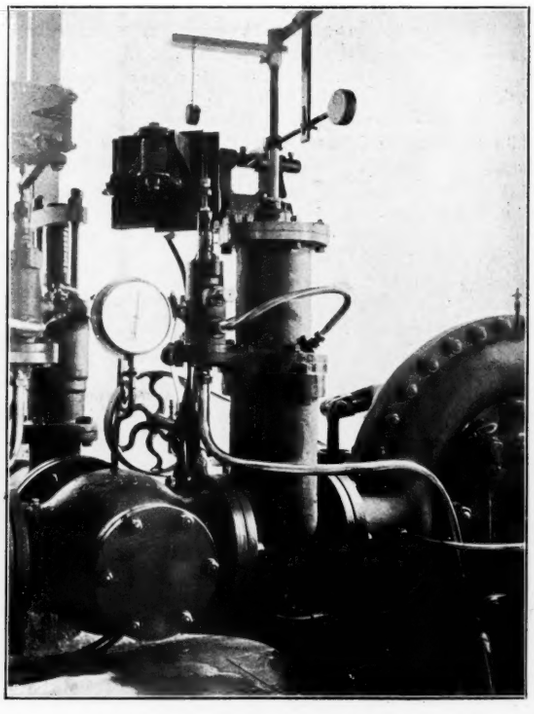
Main Switchboard and Two "Ardross" Type Radiators.

Not the least interesting part of the installation is the new Church. This was completed last summer, and, in addition to being lighted by electricity, it is fitted throughout with electric heaters. This is the only Church within our knowledge that is heated by electricity. Nearly all the radiators have been designed by Mr. Adams, as also was the special switch. The nave is provided with 22 small radiators fitted along the side walls at regular intervals under the seats; in the floor, four large heaters have been fixed under ornamental cast-iron gratings, and two more have been fitted in the platform behind the minister's chair; a wall radiator by the pulpit and a large ornamental cast-iron case radiator under the west window complete the equipment in the nave. The castle pews are in the vestry recess at the east end, and are heated by a wall radiator on one side, and on the other side under the seats are two small radiators similar to those on the walls of the nave. The vestry is provided with a large portable screen radiator.

The total current required for the radiators is 80 amperes at 160 volts, and the special switch, to which reference has been made, is required first to turn on the lights in series with a resistance absorbing 40 volts; it is left in this position when light only is required. If the heaters are needed, the circuits controlling them are switched in one by one by turning the handle, and when the last circuit but one is turned on the series lamp resistance is short-circuited; in this position 20 amperes are absorbed by the lamps and 60 amperes by the radiators. On moving the switch to the last contact the lights are turned out and the remaining radiators turned on. The various contacts of the switch are provided with carbon sparking pieces.



Ball Room.

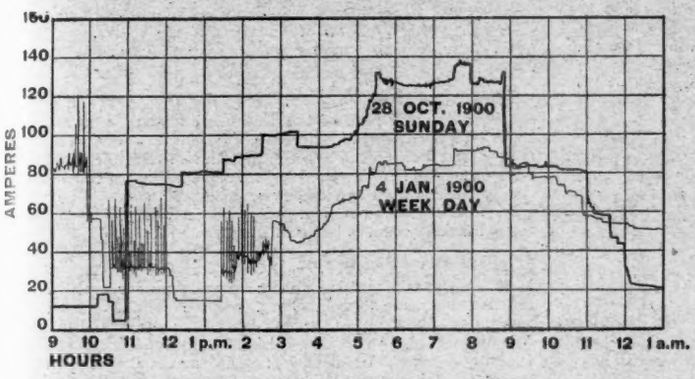


Automatic Starting Appliance.

It will be seen from this general description of the installation that the plant and switching apparatus have to meet a most unusual set of conditions, and, in addition to this, the owner specially desired that so far as possible the plant should be automatic and require a minimum of attention.

For general lighting purposes one dynamo is sufficient, but when heaters or motors are brought into use the load runs up to 150 amperes. As the man in charge cannot be constantly in attendance at the turbine house, it was necessary to devise automatic arrangements to start the second turbine and couple it to the mains when the load on the running dynamo exceeded 80 amperes.

The illustration on the opposite page will help to demonstrate how this is accomplished. A hydraulic sluice controls the admission of the water to the turbine, and the piston of this is caused to rise and fall by an equilibrium valve, which admits pressure water above or below the piston. When the valve is up the sluice is raised, and the turbine starts; when the valve is down, water is admitted to the top of the cylinder, the sluice is closed, and the turbine stops. The equilibrium valve is operated by an electro-magnet, through which the whole of the current from the running dynamo passes. When this reaches about 90 amperes, the armature of the magnet rises, and the valve with it. The turbine then starts. The gear seen above the hydraulic cylinder has recently been added to close the guide blades as the turbine stops; without this the turbine starts with too great a rush.



The thin line (January 4th) is an ordinary week-day curve in cold winter weather when the family was in residence. The other curve is a Sunday diagram in cold weather when the Castle was occupied. The chief part of the load in the latter case is due to the Church-heating apparatus and Castle radiators. During the night the load is maintained at the points where the diagram ceases.

On the switchboard, in addition to the ordinary switches and instruments, coupled three and two-way switches are fitted for coupling the dynamo leads and feeders so that either machine may be run regularly, and the second started and coupled to the mains when necessary. Two Crawley automatic switches are fitted, one for each machine; these have been specially designed to meet the very unusual conditions they are required to fulfil.

Both machines are excited from the running dynamo, and the two pairs of feeders are joined at the Castle.

When one machine is running, it is working on one set of feeders, over which a fall of potential of 20 volts takes place at 80 amperes. When the current exceeds 80 amperes, the second machine starts, and as it reaches a little over full speed, the Crawley automatic operates, and couples the positive brush to that of the first machine, and a trifle later couples it to the second positive feeder through a third automatic switch, which immediately couples the second negative feeder in parallel with the first. The two machines and the two feeders are then in parallel, and the current is equally divided; by these means the compounding of the dynamos and the fall of potential in the feeders is always in adjustment.

When the total current supplied to the feeders falls to 40 amperes, the equilibrium valve spindle falls, and the second dynamo stops.

At the moment of coupling and uncoupling there is a rise and fall in the volts of only 5 per cent. The whole apparatus answers admirably.

The switchboard is so arranged that the plant can be run with or without the automatics, and so that either machine can be used for the Castle, Church, or farm machinery separately or together.

When the plant was first installed, the condensation on the metal work on a cold day was considerable, and most troublesome, and a small stove was fitted in the turbine house. It is found, however, that two electric radiators are much more handy and serviceable, and the sweating is entirely done away with. These radiators also help to steady the turbine at very light loads.

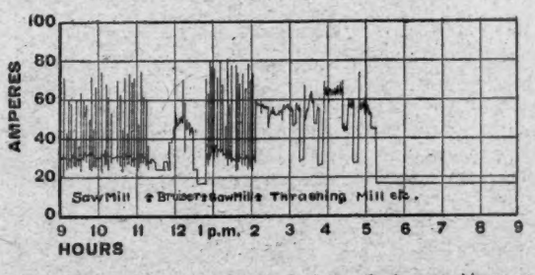
The recording ammeter, to which reference has been made, is so connected that all current used in the installation is registered, and some most interesting records have been obtained. The drum is of large size, and gives a chart for each day. From the nature of the diagram it is quite easy to distinguish what apparatus has been in use, and the motor records are valuable in that they show very distinctly how many hours the various machines have been in use.

Some records taken last Christmas, when the family was in occupation, indicate the extensive use that is made of the radiators.

As an illustration, we give a few notes of the demand of January 3rd. The circular saw and other machinery were running from 12.0 until 3.0, and a varying demand was made during these hours; at 3.20 the load rose to 65 amperes rapidly, and continued to rise until 6.20, when it had reached nearly 90 amperes. It then declined slowly until 11.0, and continued steady at 70 amperes throughout the night. At 6.30 next morning the servants rose, and the load began to increase again, reaching 100 amperes at 9 a.m. The total consumption for the 24 hours was 320 units. On Sunday, January 7th, the consumption was 250 units.

This autumn has furnished some remarkable diagrams; the weather has been cold, and considerable use has been made of the radiators. The curves taken on Sundays are very imposing now that the Church-heating installation is in use. Two, taken recently, show a demand of 310 and 320 B.O.T. units respectively. The daily demand, of course, varies at different times of the year, but rarely falls below 50 units, and when the family is in residence it rises not infrequently to over 300 units. During the year the installation has been running some 35,000 B.O.T. units have been used, and the works costs come to about ·55d. per unit, a result probably not obtained in any other installation in the country, and, moreover, a result not attained in even the largest town installation. Seeing that the family is only in residence for a few months in the year, this is additionally remarkable, and were the Castle occupied for the whole year the costs would be less than ½d. per unit.

FEBRUARY 14TH, 1900; WEEK-DAY.



This diagram shows a portion of the day load when the farm machinery was in use. On that day several different machines were used, and each gives a characteristic diagram. The family was not at the Castle when this diagram was taken, and this accounts for the small load after 5 p.m.

A word or two in conclusion with regard to the effect of a severe frost upon the flow of water will perhaps prove of interest. The Castle, as we have indicated, is some 30 miles north of Inverness and on the east coast; it is, therefore, subject to severe winter weather. In addition to this the whole of the collecting area lies at an elevation of between 800 and 2,200 feet above sea level. A spell of severe weather was experienced in the early part of this year, when the temperatures at 500 feet above sea level ranged between 9° F. and 37° F. for a fortnight; during this time an average of 100 units was used per day, and the Dam remained full throughout. To produce this result the flow must have been nearly double the minimum summer flow.

ELECTRIC TRACTION NOTES.

(*Continued from page* 826.)

Central London Railway Extension.—The Central London Railway Company gave notice on Monday of a Bill to be presented to Parliament in the coming session, to enable them to construct a double line from the Bank station to a new station to be made under the Liverpool Street station of the Great Eastern Railway Company. A small extension is also proposed to be made at Shepherd's Bush. The extensions will be constructed in the form of "loops," and thus do away with "crossing over" at the termini, which causes more delay than was originally expected. When the extensions are completed it will be possible (says the *Times*) to increase the frequency of the service somewhat.

Colne.—On Thursday last week an inquiry was held by Mr. P. Boulnois, inspector of the L.G.B., into an application by the Colne Corporation for sanction to borrow £39,000 for electrical purposes. The Corporation proposes to make provision for supplying electrical current for the purpose of working the Colne and Trawden Light Railway, which is to be constructed by Messrs. Greenwood and Batley, of Leeds. It is intended to work the railway as a continuous line from Trawden to Colne, by way of Nelson, Brierfield, Burnley and Padiham, a distance of 12 or 14 miles.

Dublin.—The Clontarf (Co. Dublin) Urban District Council had before them at their last meeting the resolution passed by the Council authorising the United Tramway Company to construct tramlines from Fairview Corner to Ballybough Bridge, on their carrying out certain works and paying a certain annual rental. This was finally adopted, but the chairman of the Council complained that the Tramway Company had had rails laid down between Gardiner Street and Abbey Street for the last 18 years, but no trams had ever been run over the track. A resolution was passed calling on the Tramway Company to give a service along Gardiner Street, Beresford Place and Abbey Street, as such would be a great convenience to the people of the Clontarf suburb.

Dundee.—There was half an hour's delay in the electric car service on 12th inst., due to a trolley arm catching a guard wire, which fell, causing a short circuit.

Edinburgh.—Several additional nails have been driven in the coffin of cable traction, for on 12th and 13th there were three stoppages in the service. That on the 13th was due to a broken gripper, and the line was clogged for an hour.

Electric Haulage on Canals.—According to the report of the Compagnie Générale de Traction Electrique sur Voies Navigables, of Brussels, the company's system of electric haulage on canals is now in service between Vergenal and Ruysbroeck, a distance of 22 kilometres, on the Brussels—Charleroi Canal, the results being considered satisfactory. The company has secured concessions to supply current for electric lighting purposes to 11 localities on the line, and is negotiating similar concessions in a number of other places.

Hendon and Finchley.—The Charing Cross, Euston and Hampstead Railway Company are seeking for powers, in the next Parliamentary Session, to extend their proposed line from Hampstead to Golder's Green, Hendon, near the cross roads. In connection with this, a company will be incorporated to lay down an electric tramway under the Tramways Act, to act as a feeder for this extension. There will be two lines of tramways, one from Golder's Green to the Tally Ho Corner, Finchley, and the other from Golder's Green to Hendon village. If these schemes are carried through, the much-felt want of direct communication between Hendon and Finchley and the West End will be supplied.

Liverpool.—Mr. S. W. Higginbottom, M.P., was re-elected chairman of the Electric Power and Lighting Committee at the first meeting of the Committee since the Liverpool municipal elections. Speaking of the work of the Committee, Mr. Higginbottom said that very important work had been done by the Committee during the past 12 months, and it was expected that there would be a considerable extension of it during the next 12 months. This would include the provision of additional machinery at the Pumpfields and Lister Drive stations.

Another new electric car route, that between Breckfield Road and Castle Street, Liverpool, was opened on Sunday last. The cars will run every seven and a half minutes. Arrangements are in progress for continuing the main lines in James Street across the entrance to George's Dock, which comes into the possession of the Corporation of Liverpool on December 1st, so that a second direct main approach to the Pierhead terminus may be obtained.

Manchester.—At a meeting of the Tramways Committee on 12th inst., Councillors Boyle and Wainwright were re-elected chairman and vice-chairman respectively. A report was submitted *re* the progress of the electrical equipment of the tramways. It was arranged some time ago that the electricity department should provide the energy for the trams, and arrangements were then made for building two new generating stations, one in Stewart Street, Bradford, and the other in Bloom Street. There is now some fear that neither of these stations will be ready to supply the electrical energy for the trams so soon as required. The matter was discussed at length by the committee, and among the suggestions that were made was one to offer premiums for accelerating the work. A special sub-committee was appointed to confer with the Electricity Committee on the subject.

Nottingham.—A trial was made on Friday night of one of the new electric cars intended for use on the section between the Nottingham Great Market Place and Sherwood. On board were Mr. Arthur Brown (city engineer), Mr. H. Talbot (city electrical engineer), Mr. J. Aldworth (manager of the city tramways), Mr. Rogerson (assistant electrical engineer), Alderman Brownsword (chairman of the Corporation Tramways Committee), and several others, including a number of employés of the contractors, Messrs. Dick, Kerr & Co., whose representative, Mr. Williams, drove the car.

Pontefract.—The T.C. met specially on 15th inst. to consider the proposals of the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, to establish a system of electrical trams in and between Normanton, Whitwood, Castleford, Glass Houghton, Pontefract, Purston, and Featherstone, and also to supply electric light and energy within those areas. The scheme received the unanimous approval of those voting, subject to the terms in the agreement being satisfactory.

Tramway Powers.—Tuesday's *London Gazette* contains numerous notices regarding new powers for which application is being made to Parliament. These include the following, relating to tramways:—Gosport Electric Tramways (Urban Electric Supply Company); Lyndhurst Light Railway (Lyndhurst Electric Light and Traction Company); Bournemouth Corporation Tramways; Burton-on-Trent Corporation tramways and light railways; Bury Corporation tramways; Handsworth U.D.C. (tramway working and leasing powers); Hyde Corporation tramways; Chester Corporation tramways; Wrexham (National Electric Traction Company).

Radcliffe.—The D.C., having obtained a provisional order for the construction and working of electric tramways in the district, are pushing forward with the scheme, and a L.G.B. inquiry is to be held shortly. The Bury Corporation have approached the Council, as they wish to run to Whitefield *vid* Radcliffe, and suggested that Radcliffe should lay a permanent way and give Bury running powers over it on terms to be hereafter settled. The policy of Radcliffe Council, however, is to retain powers over their district, and they have offered to enter into an agreement with Bury if reciprocal powers are granted. On the other side of the town an effort is being made to connect Radcliffe with Farnworth, and the two Councils are negotiating with Little Lever on the matter. The suggestion is that Little Lever should obtain a provisional order, construct the line, and lease it to the other two authorities, Little Lever to keep the line in repair, and Radcliffe and Farnworth to attend to the equipment. The cost of the Radcliffe scheme is foreshadowed at £80,000. Included in this, however, is the electric lighting scheme, and land for the establishment of the necessary plant has just been obtained, but building operations have not yet commenced.

Scarborough.—The New General Traction Company, Limited, which is connected with electric tramway systems in various parts of the country, has promoted a company styled the Scarborough Electric Tramway Company, with a capital of about £150,000, which, it is understood, is already practically assured. The scheme which the company proposes for Scarborough is a comprehensive one, and is estimated to involve an outlay of £120,000. The plans, which have been prepared, show an outer and an inner circuit embracing all the principal parts of the borough, and extending over a route of about eight miles, with about 12 miles of rails. The Corporation is to be approached to secure its approval of the undertaking. The company is understood to be willing, at its own expense, to maintain the streets along which the lines are laid, and also to light the new Marine Drive with electricity during that period of the year when the trams are running.

Victoria-Putney Underground Electric Railway.—The London News Agency states that there is a possibility that at no very distant date an electric underground railway will be constructed between Victoria and Putney. A Bill embodying the scheme will shortly be placed before Parliament. We read in the *Times* that inquiries have already been made in the district, on behalf of a firm of solicitors, as to the ownership of the property under which the proposed new railway is to be constructed. The line would be called "King's Road Electric Railway." The suggested line of route is under King's Road, on the Middlesex side, beneath the bed of the river to Putney, where it would proceed under Brewhouse Lane and the Putney Baths to the east side of High Street as far as Montserrat Road, where the terminus would be situated. It is the intention of the company to erect a generating station near to the terminus, in addition to a passenger station. Several of the tradesmen and property owners have been served with statutory notices informing them that their property will be required, and the ground landlord of several shops in High Street has received notice that all the premises between No. 67 and No. 93, at the corner of Montserrat Road, will be taken over.

Wrexham.—The National Electric Traction Company registers its intention to apply to the Board of Trade for tramway powers in the *London Gazette*.

TELEGRAPH AND TELEPHONE NOTES.

Canadian-English Cable.—We read in the New York *Electrical World* that the Canadian Dominion Government hopes to have a short direct cable laid between Scotland and Belle Isle, on the Labrador Coast of Canada, *vid* the north of Ireland, thus giving Canada a new cable line to Great Britain.

Egyptian Telephones.—A telephone line is shortly to be erected between Alexandria and Cairo.

New Cable to Shanghai.—A Reuter dispatch dated Berlin, November 16th, says that the cable steamer *Von Podbielski* arrived at Wusmey on 15th inst., and was proceeding to Tsin-tau to lay the Tsin-tau Shanghai cable. A later dispatch stated that the steamer was overdue at Shanghai.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
African:—		
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
St. Louis (Senegal)-Teneriffe	Nov. 11, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	
Zanzibar-Aden	Nov. 9, 1900	
South American:—		
Pará-Maranham	March 1, 1900	
Paramaribo-Cayenne	Oct. 6, 1900	
Barcelona - Guanta - Cumana - Portlamar - Carupano (Venezuela)	Nov. 1, 1900	
Falmouth-Bilbao	Nov. 19, 1900	
Havre-Waterville	Nov. 8, 1900	
Latakia-Cyprus	June 20, 1899	
Landlines:—		
African:—		
Mujunga-Tananarive	Nov. 6, 1900	
South American:—		
Communications with all offices of Colombia beyond Buenaventura	January 23, 1900	
Ecuador landlines	March 13, 1897	
Interior of Colombia landlines	Nov. 19, 1900	
Landlines south of Serena	July 30, 1900	Nov. 19, 1900
Landlines west of Barquisineto and Coro	Nov. 1, 1900	
Barcelona (Venezuela)-Ciudad (Bolivar)	Nov. 1, 1900	
West Indian:—		
Landlines to Baracoa, Guantago and Sagua de Tanamo	Nov. 12, 1900	
Landlines between Puerto Plata and San Domingo City	Nov. 20, 1900	
Dominican landlines	Nov. 21, 1900	
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *vid* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Communication between Saigon and North Annam and Tonkin	Oct. 23, 1900	
Saigon-Bangkok	Nov. 16, 1900	Nov. 16, 1900
Communication "*vis* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

[* We are informed that the interrupted section is the Teneriffe Coast cable.]

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—November 23rd. Tenders are invited for steam pipes, pumps, condensing plant, boilers, mechanical stokers, superheaters, coal and ash conveying plant, and switchboard extensions for the Corporation electricity works. See "Official Notices" October 12th.

Bermondsey.—December 3rd. The Vestry invites tenders for 71 cast-iron arc lamp columns, arc and incandescent lamps, automatic switches and fittings. See "Official Notices" November 16th.

Bexhill.—December 10th. The U.D.C. wants tenders for water-tube boiler and pipework, and one 150-KW. steam dynamo. See "Official Notices" to-day.

Birkenhead.—December 4th. The Corporation wants tenders for switchboard and instruments for the tramways power station, Craven Street. See "Official Notices" to-day.

Blackpool.—December 17th. The Corporation wants tenders for the supply of arc lamp carbons and oils for one year. See "Official Notices" to-day.

Brighton.—December 6th. The Council invites tenders for points, crossings, sole-plates, manhole covers and gulley-grates, tie-bars, fish-bolts, &c., for the electric tramways. See "Official Notices" November 16th.

Brighton.—December 13th. The Council wants tenders for the construction of permanent way including bonding, &c.; paving all tramway tracks with wood, &c. See "Official Notices" November 16th.

Cardiff.—November 28th. The Corporation wants tenders for a 75-KW. motor generator, Tudor battery, lead covered cables, and a 20-ton travelling crane for the tramways undertaking. See "Official Notices" November 9th.

Copenhagen.—January 3rd, 1901. The Corporation invites tenders for three 530-KW. dynamos, switchboards, &c. See "Official Notices" to-day.

Halifax.—November 27th. The Tramways Committee invites tenders for the supply of 36 tramcars, trucks, motors, and electrical equipments for same. See "Official Notices."

Hendon.—December 31st. The U.D.C. wants tenders for Lancashire boilers, stokers, pumps and economiser; two 150-KW. steam dynamos, motor transformer, &c.; condensing plant, crane, switchboard work, battery, mains, meters, and workshop equipment for electricity works. See "Official Notices" November 16th.

Kendal.—November 25th. The Corporation wants tenders for complete electric lighting station equipment (boilers, steam dynamos, battery, &c.); and for underground mains, meters and services. See "Official Notices" November 2nd.

Manchester.—December 1st. Tenders are wanted for twelve workmen's electric cars. See "Official Notices" to-day.

Newington (Southwark).—December 3rd. The Electric Light Committee of the Southwark borough, wants tenders for the erection of back E.M.F. cells at the electric light station. See "Official Notices" to-day.

Oldham.—November 27th. The Electricity Committee wants tenders for an extension switchboard for supplying current to the tramways. See "Official Notices" November 16th.

Partick.—December 4th. The Commissioners want tenders for electricity meters, demand indicators, and fuses. See "Official Notices" to-day.

Portsmouth.—December 7th. The Corporation wants tenders for permanent way construction and underground feeders for the electric tramways; also for overhead electrical equipment., See two "Official Notices" to-day.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Stockport.—November 24th. The T.C. wants tenders for the laying of permanent way for electric tramways. Also for the supply of 1,050 tons of girder rails, 90 tons of fishplates, 25 tons of tie bars, various points, crossings, bolts and nuts, &c. See two "Official Notices" November 9th.

Stockport.—November 24th. The T.C. wants tenders for the overhead equipment, and supply of rail bonds, for six sections of electric tramways. See "Official Notices" November 9th.

Tyne.—November 30th. The Tyne Improvement Commissioners want tenders for the electric lighting of the Northumberland and Albert Edward Docks, including everything but the generating plant. See our "Official Notices" to-day.

West Ham.—November 30th. The Council wants tenders for two 25-B.H.P. oil engines, two 15-KW. dynamos, battery and switchboard for the Dagenham Hospital, Essex. See "Official Notices" to-day.

CLOSED.

Dublin.—The Electric Committee of Dublin have been considering the tenders for cables required under the new electricity scheme. Three firms tendered:—Messrs. Siemens Bros. & Co., of Westminster, at £103,237 12s.; the St. Helens Cable Company, at £108,039 15s., and the British Insulated Wire Company, at £109,447 10s. 8d. The tender of Messrs. Siemens had been practically accepted, when it was discovered that a trifling little mistake of about £10,000 had been made, raising the amount to £113,637 12s. Mr. Hammond now advises that the tender of the British Insulated Wire Company be accepted, but it is being asked why this should be, if the St. Helens Company can do the work £1,400 cheaper. Mr. Hammond says in this connection, that the firm being of recent origin, he should hesitate before placing with them a contract of such magnitude.

London.—The London County Council have accepted tenders from the following firms for the supply of engineers' goods and electrical stores during the ensuing year:—J. Dickson, M. Wilson & Co., Pyke & Palmer, Buck & Hickman, J. Russell & Co., Turner & Hudson, Edison & Swan Company, Heaton & Smith, and Simon, Berry & Co.

Woolwich.—Owing to the rapid extensions since the Woolwich Electric Light Company has been taken over by Messrs. Edmundsons, a second 250-KW. turbo-dynamo, complete with surface condenser, air and circulating pumps, has been ordered from Messrs. C. A. Parsons and Co.

Tunbridge Wells.—The Council has accepted the tender of Messrs. Callender & Co. for the supply of high and low tension electricity cables, with the exception of the twin public lighting cable, Messrs. W T. Henley's tender being accepted for this only. The tenders submitted were as follows:—

Low Tension Electricity Cables.

Name of firm.	·034	·06	·1	·15	·2	Twin.
	£ s. d.	£ s. d.	£ s.	£ s.	£ s. d.	£ s.
B it. Insul. Wire Co.	135 0 0	193 0 0	246 0	322 0	384 0 0	65 0
Callender & Co. ..	**109 0 0***	**168 0 0***	**228 0***	**295 0***	**354 0 0***	70 0
W. T. Glover & Co.	114 11 8	175 0 0	237 10	312 10	389 11 8	68 15
Henley & Co. ..	106 5 0	165 17 6	299 5	305 0	375 15 0	**46 10***
Johnson & Phillips	107 0 0	166 0 0	231 0	312 0	378 0 0	50 0
J. Littauer ..	102 11 0	164 10 0	228 6	306 10	375 1 0	25 10
Polland & Co. ..	126 8 0	187 6 0	256 8	336 17	409 15 0	78 4
Siemens Bros. & Co.	109 0 0	161 0 0	222 0	295 0	354 0 0	60 0
St. Helens Cable Co.	115 10 0	173 0 0	238 0	311 0	373 0 0	66 8
Western Electric Co.	115 0 0	168 0 0	230 0	296 0	362 0 0	62 0

* Accepted. Prices per 1,000 yards.

High Tension Electricity Cables.

Name of firm.	·025	·034	·05	·1
	£ s. d	£ s. d.	£ s. d.	£ s. d.
Brit. Insulated Wire Co.	144 0 0	164 0 0	210 0 0	290 0 0
Callender & Co. (accepted)	**113 0 0**	**131 0 0**	**175 0 0**	**257 0 0**
W. T. Glover & Co. ..	118 15 0	137 10 0	191 13 4	272 18 4
Henley & C. ..	113 10 0	129 12 6	178 2 6	266 0 0
Johnson & Phillips ..	116 0 0	138 0 0	188 0 0	274 0 0
J. Littauer	115 10 0	130 0 0	171 0 0	250 0 0
Polland & Co.	163 4 0	242 6 0	250 19 0	321 17 0
Siemens Bros & Co. ..	116 0 0	130 0 0	175 0 0	257 0 0
St. Helens Cable Co. ..	121 10 0	140 0 0	190 0 0	276 0 0
Western Electric Co. ..	124 0 0	140 0 0	186 0 0	263 0 0

Prices per 1,000 yards.

Durban (Natal).—We are indebted to our South African exchange, *Industries*, for the following list of tenders which were submitted to the Durban Corporation for the electric tramway scheme. As has been already stated in our columns, the successful tenderers were:—

Messrs. Macartney, McElroy & Co., Limited, of London, for Part "A," £16,994 10s. 10d., and Part "B," £18,600, making a total of £35,594 10s. 10d., while

Messrs. Dick, Kerr & Co., Limited, of London, secured Part "C" for £26,240 10s. 10d.

The total contract amounted to £61,835 0s. 10d. It is divided into:—Part "A," Poles and overhead equipment; Part "B," Electric motor cars; Part "C," Steam and electric generating plant.

Sunderland.—The T.C. at their last meeting accepted the recommendation of the Tramways Committee that the contract for 24 motor cars of the top-seat type, together with track cleaner and traverser, for which tenders were recently invited, be awarded to Messrs. Dick, Kerr & Co., Limited, at a price of £675 per car. All of these cars will be equipped with standard air brakes.

London.—The Asylums Committee of the London County Council have accepted the following tenders in connection with the central station, for the supply of water and the electric light at Horton asylum:—Boilers, engines, and dynamos, the Edmundson Electricity Corporation, £17,825; pumps and pumping machinery, R. Warner & Co., £1,674 10s.; water softening plant, Doulton & Co., £1,269 12s.; and fencing, Turner, Limited, £602 10s.

FORTHCOMING EVENTS.

Friday, November 23rd.—At 5 p.m. Physical Society. Agenda: (1) "The Anomalous Dispersion of Carbon," by Prof. R. W. Wood; (2) "The Liquefaction of Hydrogen," by Mr. M. W. Travers; (3) "On the Refraction of Sound by Wind," by Dr. E. H. Barton.

At 7.30 p.m.—Institution of Junior Engineers. Joint meeting with the Architectural Association at 9, Conduit Street, W. Paper on "The Use of Rolled Joists in Construction," by Mr. A. T. Walmisley, M.I.E.E.

Saturday, November 24th.—At 10.10 a.m. The Institution of Electrical Engineers (Students' Section). Visit to works of Messrs. Siemens Bros. & Co., Limited.

Monday, November 26th.—At 8 p.m. Society of Arts, Cantor Lectures. "Electric Oscillations and Electric Waves," by Prof. John Fleming, M.A., D.Sc., F.R.S. Four Lectures. Lecture 1.—Electric Oscillations.—The production of electric oscillations—The factors determining their frequency and energy—Secondary oscillations—Magnetic, thermal and other effects produced by electric oscillations.

Tuesday, November 27th.—At 7.30 p.m. Institution of Electrical Engineers, (Manchester Section). Meeting at Owens College, address on "Relative Advantages of Direct Current and Three-Phase Distribution for Small Installations," by H. A. Earle, M.I.E.E.

Wednesday, November 28th.—At 7.3 p.m. The Institution of Electrical Engineers (Students' Section). Papers to be read:—"Single-phase Generators at the Paris Exhibition" by J. T. Irwin, and "Polyphase Generators at the Paris Exhibition" by C. N. Nettley.

Tenderers.	Time of completion in months.	No.	Part "A."	Part "B."	Total "A" & "B."	Part "C."	Total contract.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Lowdon Bros. & Co., Dundee	—	1	17,287 0 6	15,905 0 0	33,192 0 6	21,337 0 0	54,400 0 0
" " "	—	2	—	16,015 0 0	33,302 0 6	—	—
Reunert & Lenz, Durban & Johannesburg	10 to 12	1	16,427 13 3	18,300 0 0	34,727 14 3	22,850 0 0	56,577 0 0
" " "		2	—	22,150 0 0	38,577 14 3	23,600 0 0	61,177 0 0
J. G. White & Co., New York & London	9 to 11	1	19,883 1 2	18,296 0 0	38,179 1 2	22,209 0 0	58,000 0 0
" " "		2	—	18,120 0 0	38,003 1 2	22,209 0 0	57,824 0 0
R. W. Blackwell & Co., Ltd., London ...	10 to 12	1	19,241 6 3	21,702 6 8	40,943 13 4	20,417 10 0	59,862 17 9
" "	"	2	—	23,447 5 2	42,688 11 10	20,417 10 0	61,777 16 3
" "	"	3	—	21,702 6 8	40,943 13 4	24,017 10 0	63,362 17 9
" "	"	4	—	23,447 5 2	42,688 11 10	24,017 10 0	65,107 16 3
Macartney, McElroy & Co., Limited, London (accepted A & B)	12 to 14	1	16,994 10 10	18,600 0 0	35,594 10 10	25,255 0 0	60,849 10 10
	"	2	—	18,820 0 0	35,814 10 10	25,255 0 0	61,069 10 0
Brush Electrical Engineering Co., Ltd., London	12 f.o.b. London	1	18,947 12 0	23,498 0 0	42,445 12 0	24,175 0 0	66,620 12 0
		2	—	22,376 0 0	—	—	—
Crompton & Co., Ltd., London	16 to 19	1	21,332 13 3	20,397 0 0	41,729 13 3	25,798 0 0	67,527 0 0
Siemens, Ltd., Durban	11 to 18	1	25,379 0 0	19,534 12 0	44,913 12 0	23,742 0 0	68,500 0 0
" "	"	2	23,008 0 0	19,534 12 0	42,542 12 0	23,742 0 0	66,129 0 0
Dick, Kerr & Co., Lon. (accepted C)	8 to 11	1	22,096 0 0	22,424 0 0	44,520 0 0	26,240 10 0	70,598 0 0
" "	"	2	—	23,165 0 0	42,521 0 0	—	—
" "	"	3	—	—	—	21,379 10 0	65,598 0 0
Hubert Davies & Spain, Durban	10 to 12	1	18,457 6 9	24,226 0 0	42,683 6 9	26,628 0 0	69,311 0 0
" "	"	2	—	22,730 0 0	47,187 6 9	—	—
" "	"	3	—	8 Alternative Tenders from	to	24,010 0 0	66,693 0 0
						30,723 10 0	76,704 0 0
Reiners Von Laer & Co., Port Elizabeth	15	1	25,446 2 10	24,972 0 0	50,238 2 10	21,600 0 0	71,838 0 0
British Schuckert Electric Co., Ltd., Lon.	—	1	26,839 17 0	21,950 0 0	48,789 17 10	28,725 0 0	75,500 0 0
" " "	—	2	—	21,620 0 0	48,550 17 10	—	—
Hamilton & Co., Port Elizabeth	—	—	25,446 0 0	24,792 0 0	50,238 0 0	28,650 0 0	78,100 0 0
Witting Bros., Ltd., London, on behalf of Electricité & Hydraulique, Charleroi...	—	—	125,368 0 0	26,300 0 0	151,668 0 0	26,350 0 0	178,018 0 0
George Hill & Co., Manchester	—	—	26,626 14 0	23,050 0 0	49,676 14 0	—	—
Mather & Platt, Ltd., Manchester ...	—	—	—	—	—	23,176 0 0	—
Davey, Paxman & Co., Colchester ...	—	1	—	—	—	23,452 15 0	—
" "	Not stated.	2	—	—	—	27,001 10 0	—
Clayton Engineering & Electrical Construction Co., Ltd., Hyde, Manchester	Not stated.	—	—	—	—	24,313 1 6	—
D. Stewart & Co., Glasgow	—	—	—	—	—	27,568 10 0	—

Thursday, November 29th.—Extra meeting of the Institution of Electrical Engineers, in the rooms of the Institution of Mechanical Engineers. Paper by Mr. W. E. Langdon, on "The Supersession of the Steam by the Electric Locomotive."

Institution of Electrical Engineers (Dublin Section). Conversazione at the Royal Dublin Society. [This will take the place of the meeting announced for the 22nd inst., which was postponed from that date.]

Friday, November 30th.—At 8 p.m. Institution of Junior Engineers. Inaugural Meeting of 20th session, Westminster Palace Hotel, Sir Lowthian Bell, Bart., F.R.S., delivers the Presidential Address.

Saturday, December 1st.—At 2.0 p.m. and 3.0 p.m. The Institution of Electrical Engineers (Students' Section). Visit to Generating Station of Waterloo and City Railway.

Thursday, December 6th.—Röntgen Society Meeting, paper on "Stereoscopic Fluoroscope and new Mercury Break," by Mackenzie Davidson.

At 8 p.m.—Civil and Mechanical Engineers' Society Meeting, paper on "Valve Gears and Valve Diagrams," by Prof. R. H. Smith, M.I.E.E., &c.

Saturday, December 8th.—At 3 p.m. Visit of Institution of Junior Engineers to the London United Tramways Company's electric generating station at High Road, Chiswick.

NOTES.

The Use of Röntgen Rays.—At an inquest held at Hastings on 16th inst., there were certain statements made regarding the use of Röntgen rays in the diagnosis of a fractured thigh. The deceased, a widow lady of 68 years of age, had written a letter stating that she had suffered great pain and anguish from a sore caused by over exposure to Röntgen rays. It seems that whilst the patient was being attended by Dr. H. R. Mansell, Röntgen rays were twice applied under the circumstances recorded in the evidence, which was as follows :—

Dr. Roberts, of Hastings, stated that when called in on July 7th deceased had a sloughing wound on the stomach, 7 inches by 3¼ inches, with a considerable amount of inflammation surrounding it. He thought it probable it was attributable to Röntgen rays. The cause of death was exhaustion from the effects of shock from the two injuries, fractured thigh and Röntgen rays. He had read of cases reported of dermatitis being set up by Röntgen rays. He had never before heard of a sloughing wound after Röntgen rays. At the *post-mortem* examination it was found that the body was wasted. He could not give the date when Mrs. Wilson lost her reason, because she varied, but he thought it was about a month before she died. He did not think a sloughing wound of this size would cause wasting sufficient to bring about death.

Mr. A R. Ticehurst, surgeon, of St. Leonards, said the sore might have been caused by Röntgen rays or something else, such as a hot-water bottle.

Dr. Mansell said deceased consented to have Röntgen rays used on her thigh. He consulted Mr. Blomfield, who said he thought he would have to give 35 minutes' exposure. He gave Mr. Blomfield directions to take two plates, one of the affected side and another of the right side, which was unaffected. On the following morning he visited Mrs. Wilson, who was very well in every respect, and who never complained of any inconvenience whatever from the application of the rays. He showed the photograph to other doctors, and it was not considered satisfactory. It was suggested that one should be taken of the centre of body. This was taken on April 27th, Mr. Blomfield saying it would take 35 minutes or a little longer.

Mr. J. H. Blomfield said he had taken photographs by Röntgen rays for various surgeons. On the first occasion he gave 35 minutes' exposure for the first plate and 45 for the second. On the next occasion he allowed 45 minutes. If he had had the later pattern of apparatus it might not have taken so long. On both occasions, in reply to his questions, Mrs. Wilson said she was not at all in pain, and quite comfortable. With an up-to-date machine he would give an exposure of five minutes.

Dr. H. Lewis Jones, medical officer in charge of the Electrical Department at St. Bartholomew's Hospital, stated that, having regard to the instrument and the part of the body photographed, he considered there had been a proper exposure. The risk of an X rays' burn was always present in long exposures. In reply to Mr. Saunderson, who represented deceased's relatives, Witness said the latest way of taking these photographs with up-to-date machines was to give as short an exposure as possible. He had given a 40 minutes' exposure, but the usual one was seven or eight minutes. He had never come across a case in which a burn from the rays caused death. Machines like Mr. Blomfield's were used all over the country.

The jury returned a verdict to the effect that the deceased met her death from shock and exhaustion following the accident, and from the effects of the Röntgen rays on a weakened system, and no blame attached either to the medical man or the photographer.

Foreign Trade Competition.—Mr. J. M. Rennoldson, who presided on Saturday night at the annual gathering of the Newcastle and District Association of Foreman Engineers and Mechanical Draughtsmen, referring to the question of competition, said (according to a *Times* summary) that foreign competition was already setting in, and he was afraid that they might feel it in the time to come a good deal more than they had yet done. Materials had been forced up to an abnormal price, and the price of coal had reached a figure which it had never reached since the early seventies, at the time of the great coal famine; the cost of the finished article had been pushed up in consequence. During recent months they had seen steel landed from America in thousands of tons, and also from Germany. From being the first manufacturing nation in the world, we began to find now that other nations were creeping in, and were to some extent taking the lead. If we were to combat successfully this competition, it would be necessary not only for the proprietors of works and capitalists to put their hand to the plough and be diligent as to their adopting the best class of machinery and the best known methods of manufacture, but it was necessary that they should be supported in their endeavours by associations such as he had the honour of addressing. Unless they had an administrative body in their works composed of their draughtsmen and managers and their leading foremen, who had studied economy and every possible means of producing work in the most economical and efficient manner, they would never be able to compete successfully with those great nations that were now competing with them. He had not a word to say against trade unionism so long as it was kept within its proper limits. There were many ways in which trade unionism could be beneficial to its members; but when it put down its foot and said to a workman that he was not to do his best for himself and his employer, it was slowly and surely strangling the industrial life of this nation. He was convinced that the success of America was mainly due to the freedom which existed amongst American workmen.

Telephone Stations for High Tension Installations.—On the 17th inst. Dr. Puluj gave a demonstration of his new safety telephone station for high tension installations. He pointed out the dangers which the users of telephones would incur if conductors carrying high tension currents should accidentally come in contact with the telephone wires. The fuses at present fitted protect the apparatus, but not the persons using it, since sufficient electricity will pass before the fusion takes place to cause serious injury. Puluj's telephone station is so constructed, that complete protection is given against currents at a tension of several thousand volts. One or both wires of the telephone shown at the demonstration were connected to the terminals of a transformer, whose tension was 3,000 volts, yet no disturbance beyond a weak humming sound in the telephone was produced. The current was regulated so that the current from the transformer heated the fuse to redness, and yet the telephone could be safely taken in the hand. The telephone stations that have been constructed after Puluj's design are for a power transmission station near Prague, working with a tension of 2,000 volts. For this information we have to thank the bankers, J. G. Selig, of Prague, who have been entrusted with the development of the invention.

Dr. Fleming's Lectures.—Dr. J. A. Fleming writes to us as follows :—"My attention has been drawn to the fact that the dinner of the Institution of Electrical Engineers has been fixed for Monday, December 3rd, and this is the same date as that announced for the second lecture of my Cantor Course at the Society of Arts on "Electrical Oscillations." Under these circumstances, some who desire to attend the lectures have asked me if it would be possible to have the date of my second lecture altered, and Sir Henry Wood, the Secretary of the Society of Arts, has kindly consented to change the date from Monday, December 3rd, to Tuesday, December 4th. You would greatly oblige me by making this announcement in your columns, so that any who desire to attend the lectures may be saved from disappointment by coming to the rooms of the Society of Arts on the wrong evening."

Horsing Electric Tramways.—The following letter came to hand too late for insertion in our "Correspondence" columns:—"I notice that Mr. Horace Boot, in his letter to you, states that the question of horsing tramways during the hours of lapping load is not his suggestion, but is one 'propounded' by me. 'Propounded' is a weighty word, and I should like to have an opportunity of stating that six years ago, before the Incorporated Association of Municipal and County Engineers, I read a paper on 'Electric Street Tramways,' consisting of some 1,200 lines of print, in which the 'propounding' referred to was accomplished within the compass of 11 lines as follows:—

> There is a third plan which the writer has lately been considering, and which might, indeed, prove the most economical method of dealing with the overlapping difficulty, viz., the *horsing* of the tramcars during the time of the top lighting load.
>
> In conversation with a leading provincial jobmaster, the writer finds that in many cities horses are jobbed out to do purely light day work, and that it would be a boon to the jobmaster to be offered employment to which they could be put during the evening. As doubtless the members of the Association have the control of the horses belonging to their respective local authorities, it will be useful to gather their opinion upon this point.

It will be noticed that I simply took the opportunity of inviting the members of the Association who had control of horses to give their opinion. I may add that those opinions were unanimously adverse to the idea, and I have from that time to this not considered it within the range of practical politics, and therefore I naturally do not desire to be treated as one who is anxious to see it carried out. During the past six years one has certainly learnt that the running of tramways electrically is an industry of such vast importance that one can afford to have special plant for it, and not to fall back upon horse flesh at any time of the day.—Robert Hammond."

The Metropolitan Railway and Electric Traction.—Tuesday's *Yorkshire Daily Post* contained the following very important announcement:—"Notice was published yesterday of the intention of the British Westinghouse Electric and Manufacturing Company, Limited, to bring in a Bill next session to enable them to undertake the electrification of the Metropolitan and Metropolitan District Railways, and to suspend the running powers of the London and North-Western, the Great Northern, the Midland, the South-Eastern, and London, Chatham, and Dover, while the process of conversion from steam to electricity is being effected."

The *Westminster Gazette* of Wednesday contained the following relative to the same subject:—"If we read the *Express* aright, Sir William Preece has told it that the Metropolitan directors will on Saturday week open tenders they have received for converting their line into an electric railway. Amongst the tenderers named are Mather & Platt, the Brush Electric Company, Crompton & Co., Thomas Parker & Co., and Dick, Kerr & Co., representing England; the Thomson-Houston Company and the Westinghouse Company, representing America; the Allgemeine Electricitat Gesellschaft, Siemens Brothers, Schuckert & Co., and Felten and Guilleaume, representing Germany; and the Breguet Electrique Company, and MM. Hutin and Leblanc, representing France. There is a hint that because of the lack of specifications the tenders will have to be made all over again, so that the electrification is not just yet."

We do not know how far these statements may be accurate, but we are in a position to say that the Earl's Court electrical experiment is at an end, and the train is no longer running. It is confidently hoped that the work of installing electric traction will commence with the new year.

Marriage.—On October 11th, at St. Thomas, D.W.I., Mr. Charles Burr Cruickshank, M.A., A.G.T.C., chief electrician, West India and Panama Company's Cable ss. *Grappler*, was married to Hermine Marie Louise, eldest daughter of Gabriel Anciaux, Esq., Brussels.

Boiler Tube Burst.—A boiler tube burst in the boiler house at the Sardinia Street station of the Metropolitan Electric Supply Company a few days ago. A young man named Albert Shirley, who was in charge, was frightfully scalded, and was at once removed to a hospital.

Light Cure.—Reuter's Copenhagen agent quotes from the *Elektroteknish Tidsskrift*, of Copenhagen, to the effect that a Danish electrical engineer has invented an electrical lamp which will cause a considerable advance in the therapeutical treatment with light followed by the Danish Prof. Finsen. The lamp has been tested at Finsen's Hospital for treatment with light in Copenhagen, and has been proved to produce in an especial degree those chemical rays which are necessary for the purpose.

The Institution of Electrical Engineers.—The Manchester Section held their first meeting on Tuesday last week in the lecture theatre of the new physical laboratories at Owens College, Dr. Edward Hopkinson presiding. There were about 100 members and visitors present to hear a lecture by Prof. Schuster on "Some Phenomena of Electric Sparks." The next paper will be read by Mr. Hardman H. Earle, and the subject will be "Relative Advantages of Direct Current and Three-phase Distribution for Small Installations."

The Rivers of Norway.—When the coal supply of Europe is exhausted, happy will be the country that has plenty of water-power. Norway will then be one of the happiest, as may be learnt from the excellent little pamphlet "Les Rivières de la Norvège," by G. Saetren, Director-in-Chief of the Administration of Canals of the Kingdom of Norway. The principal watershed of Norway lies quite close to the western seaboard, with the result that the longest rivers flowing south-east are five to six times the length of the rivers flowing west. For the same reason all the great waterfalls are on the west, some in that quarter having a perpedicular drop of over 400 feet. There are also, however, numerous waterfalls on the rivers on the east side, which are already considerably utilised for the production of power, in some cases for the generation of electricity. An excellent map is published with the pamphlet showing clearly by different colours the extent of each river valley. The courses of all the principal rivers are described in detail, their volume and the fluctuations of their flow. Such a work as this should be published for every civilised country, so that engineers might be able to determine the most suitable situations for power stations and estimate roughly the amount of the power available.

Institution of Junior Engineers.—The list of papers for the 1900-1901 session contains the following:—February 8th, "Electric Power Supply in the Metropolis," by Mr. Louis F. Awde, Mem., of London; March 1st, "Shield-Driven Tunnelling," by Mr. A. Woodroffe Manton, M.Inst.C.E., Mem., of London; May 3rd, "Electric Traction," by Mr. Frederick S. Pilling, A.M.I.Mech.E., Mem., of Devonport.

Obituary.—The death is announced of Prof. George Frederick Armstrong, who has, since 1885, occupied the chair of Regius Professor of Engineering at Edinburgh University.

The Institution of Civil Engineers.—The next papers for consideration after next Tuesday's meeting will be:—

1. "The Signalling on the Waterloo and City Railway," and
2. "Note on the Signalling of Outlying Siding Connections," by Alfred Weeks Szlumper, M.Inst.C.E.
3. "Signalling on the Liverpool Overhead Railway," by Stephen Butler Cottrell, M.Inst.C.E.

Presentation.—On Wednesday last week Mr. G. M. Harriss was presented with an appreciative address by the members of his late staff at the Bray electricity works, where he was until very recently chief electrical engineer. Mr. A. G. Hiscock, the chief assistant, presided, and Mr. T. Tomlinson, who has taken Mr. Harriss's place, was also present.

Electrical Engineers R.E. Volunteers.—The *Norham Castle* left South Africa for England on 17th inst., having on board seven officers and 42 N.C.O.'s and men of the E.E. Corps. It is announced that sanction has been given to the corps of Electrical Engineer Volunteers for their borrowing £6,000 from the Public Works Loan Commissioners for the construction of headquarters buildings.

Appointments Vacant.—A superintendent of mains is wanted for the Worcester electricity undertaking at £120 per annum. An engineer-in-charge is required for Newport electricity works at 45s. per week. A switchboard attendant is required for the Leyton electricity works. The Middlesbrough Corporation want an assistant electrical engineer at £104 per annum; also a jointer. A jointer is wanted for Colchester. The Bethnal Green Guardians want an assistant engineer for the electricity plant. See "Official Notices" this week.

Lecture.—On 14th inst. Mr. H. A. Mavor lectured on "Electric Power" at the Weaving, Dyeing, and Printing College, Calton, Glasgow.

SUPPLY STATION ACCOUNTS.

Bolton Corporation Electricity Accounts.
Private supply, public lighting and traction.

If the accounts of the Bolton Corporation electricity department are closely examined, it will be seen that they are particularly favourable both on the engineering and financial sides. Mr. A. A. Day, who has succeeded Mr. Arthur Ellis, will find it difficult to materially better the results shown. A large increase has been made in capital expenditure, in output and in profit, these being probably attributable to the traction load. A comparison between the last two years will show that private consumers have, however, all along been the mainstay of the business, and the public lighting is almost at a standstill.

Year.	Generated.	Traction.	Private.	Public.	Total.
1898 ...	560,375	...	406,306	10,329	416,635
1899 ...	1,174,478	255,000	559,406	10,386	824,792

The growth of the undertaking is made evident from the figures above, and is also proved by those set out below:—

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£67,253	**£117,590**	£50,337
Number of units sold	416,635	**824,792**	408,157
Number of lamps connected ...	43,740	**56,705**	12,965
Maximum load in amperes. Excluding tramways	...	**640**	...
Gross revenue	£7,942	**£12,087**	£4,145
Gross expenditure	3,406	**£6,184**	2,778
Gross profit	4,536	**£5,903**	1,367
Average price per unit sold ...	4·02d.	**3·22d.**	−·80d.

There are now 61,500 yards of main laid to which 751 consumers are connected, and 56,705 8-c.p. lamps or equivalent are supplied. The receipts from sale of energy have fallen by ¾d. to just over 3¼d., while other reductions have brought the total receipts from all sources down to about 3½d., over 1d. less than in 1898.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase
Sale of energy	£6,987	4·02d.	**£11,081**	3·22d.	−·80d.
Meter rents	219	·12d.	**296**	·09d.	−·03d.
Supply of lamps, &c.	736	·43d.	**710**	·21d.	−·22d.
Sundry fees	...	...	...	...	...
Gross revenue ...	£7,942	4·57d.	**£12,087**	3·52d.	−1·05d.

The coal bill is the only item in the costs sheet with a plus mark. The exceptionally favourable figure of ·48d. has now become ·78d., but the economies in all the other items swamp this charge, and leave works cost practically unaltered and total costs at 1¼d., or nearly ½d. less than before.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£838	·48d.	£2,695	**·78d.**	+·30d.
Oil, waste, water and engine room stores	347	·20d.	400	**·12d.**	−·08d.
Salaries and wages incurred in generation and distribution	1,086	·63d.	1,384	**·40d.**	−·23d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	189	·11d.	373	**·11d.**	·00d.
Works cost ...	£2,460	1·42d.	£4,852	**1·41d.**	−·01d.
Rent, rates and taxes ..	249	·14d.	417	**·12d.**	−·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	400	·23d.	610	**·18d.**	−·05d.
Establishment charges, stationery and printing, law charges and insurance	231	·13d.	305	**·09d.**	−·04d.
Other expenses	66	·04d.	...	...	−·04d.
Total costs ...	£3,406	1·96d.	£6,184	**1·80d.**	−·16d.

The financial charges have been more than met by the enhanced gross profit, and now amount to 1·3d. per unit. The profit as surplus is about £250 greater than in 1898, and represents a sum of £1,451 (or ·42d. per unit). Of this £1,000 has been transferred to the credit of the rates, and the difference or £451 has been placed to the reserve fund.

Profit Statement.

	1898.	1899.	
Interest on loans and overdraft ..	£1,599	£2,440	= 1·3d. p.u.
Sinking fund for repayments ..	1,732	2,012	
Net profit carried to reserve fund	205	451	= ·42d. p.u.
" " credit of rates	1,000	1,000	
Gross profit	£4,536	£5,903	

CITY NOTES.

Aron Electricity Meter, Limited.

The report of the directors to be submitted to the third ordinary general meeting to be held at Winchester House on Thursday December 13th, at 3 p.m. reads as follows:—

The directors have the pleasure to submit second accounts of the company, duly audited, for the term of one year ending September 30th, 1900. The directors are highly gratified with the result of this year's working, which marks a considerable further improvement on the previous satisfactory progress. The balance to credit of profit and loss for the year ending September 30th, 1900, amounts to £23,915 0s. 10d. To this is added the amount of £2,522 13s. 11d. carried forward, making a total of £26,437 14s. 9d. The directors propose to deal with the above available sum of £23,437 14s. 9d. as follows, which is in accordance with Clause 5 of the memorandum of association of the company:—

£7,493 15s. 2d. for dividend of 6 per cent. per annum on the preference shares, of which an interim dividend of £3,746 17s. 7d. was paid on April 1st last;
980 6 5 bonus to preference shareholders, of which it is proposed to carry £855 16s. 10d. to the credit of preference shareholders for next year, and to declare an additional ½ per cent. per annum for the present year, thus making a total dividend of 6½ per cent. on preference shares;
15,000 0 0 for dividend of 12 per cent. on ordinary shares;

£23,474 1 7 leaving an amount of
2,963 13 2 to be carried forward to next year.

£26,437 14 9

The business of the company continues to prosper, and the outlook is brighter than ever. The Aron meter is being adopted in the principal central stations in the United Kingdom, the Continent of Europe, and the Colonies, and this has necessitated the adoption of means for the extension of manufacturing resources. The company has successfully competed at the present Exhibition in Paris, and has obtained the Grand Prix, which is the highest award. Two of your directors, Messrs. R. E. B. Crompton, M.I.C.E., M.I.E.E., and Hugo Hirst, M.I.E.E., retire from office by rotation this year, but being eligible offer themselves for re-election. Messrs. Price, Waterhouse & Co. have acted hitherto as auditors, and offer themselves for re-election.

Mr. Garcke's Directorships.

Statements having been circulated among the shareholders of the British Electric Traction Company, commenting on the number of companies of which he is a director, Mr. E. Garcke has also circularised the shareholders of the B.E.T. Co., explaining his position. He says:—"The statements referred to are entirely misleading. All the companies of which I am a director are—with only one exception—associated companies of the British Electric Traction Company, in which that company has very large interests. I am a director of these companies in virtue of my position as managing director of your company, and by the instruction of your board. Whatever fees or remuneration I receive from any of these companies are paid over to the British Electric Traction Company. The fact that it is necessary for the business of the British Electric Traction Company to be carried on mainly by means of separate companies has already been fully stated to the shareholders in the annual reports. Those companies are in the nature of departments of your business, and it is the wish of your board that I should for a time, at any rate, share both the responsibility and the satisfaction of establishing these companies on a successful basis. Prior to the formation of the British Electric Traction Company, I was a director of several electric lighting companies, *e.g.*, the County of London Electric Lighting Company and the Chelsea Electricity Company, but when, last year, my work as your managing director became heavy, I voluntarily resigned my directorships on all companies not directly associated with the British Electric Traction Company, with only one exception. The exception is the Electric and General Investment Company, of which I have been a director since its formation 10 years ago, and I have retained my seat on that board at the request of your chairman."

Stock Exchange Notices.—Applications have been made to the committee to appoint a special settling day in and to grant a quotation to—Blackheath and Greenwich District Electric Light Company, Ltd.—Provisional certificates for £100,000 4½ per cent.

first debenture stock. The Committee has also been asked to appoint a special settling day in—Notting Hill Electric Lighting Company, Ltd.—Further issue of 2,200 ordinary shares of £10 each, fully paid, Nos 10,001 to 12,200. The committee has further been asked to allow the following securities to be quoted in the official list: Calcutta Tramways Company, Ltd.—£250,000 4½ per cent. first debenture stock.

Applications have been made to the committee to appoint a special settling day in and to grant a quotation to—British Electric Traction Company, Limited.—Further issue of 10,000 6 per cent. cumulative preference shares of £10 each, fully paid; and 15,000 ordinary shares of £10 each, fully paid. The committee has ordered to be quoted in the Official List:—Hove Electric Lighting Company, Limited.—11,000 shares of £5 each, fully paid, Nos. 1 to 11,000.

The Western Telegraph Company, Limited.—An extraordinary general meeting of this company will be held at Winchester House on Monday next, at 11.30 o'clock a.m., to confirm the resolution passed on October 30th, altering Article 110.

The Direct West India Cable Company, Limited.—The trustees for the debenture holders will receive offers of debentures for purchase on December 4th at the offices, 33, Old Broad Street.

The Halifax and Bermudas Cable Company, Limited.—The trustees for the debenture holders will receive offers of debentures for purchase on December 4th, 1900, at 33, Old Broad Street.

The City and South London Railway.—The *City Press* states that in connection with the Angel extension of this railway the company are offering 10,000 new ordinary £10 shares at £5 10s.

Baker Street and Waterloo Railway Company.—Allotments for over £1,000,000 were posted on Saturday.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 17th, 1900, were £156; corresponding period last year, £174; decrease, £6. Total to date, £19,413; corresponding period last year, £19,415; decrease, £2.

The Bristol Tramways and Carriage Company.—The receipts for the week ending November 16th, 1900, were £2,860 7s. 5d.; corresponding period last year, £4,897 13s. 3d.; decrease, £2,037 5s. 10d.

The Central London Railway.—The receipts for the week ending November 17th, 1900, were £5,406; previous week, £5,699; decrease, £293. Total receipts to date (16 weeks), £82,167. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending November 18th, 1900, were £1,866; corresponding week last year, £1,046; increase, £820. Total to date, £32,108; corresponding period last year, £19,473; increase, £12,635. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending November 15th, 1900, were £351 8s. 9d.; corresponding week last year, £359 14s. 5d.; decrease, £8 5s. 8d. Total to date, £18,995 2s. 1d.; corresponding period last year, £17,501 5s. 4d.; increase, £1,493 16s. 9d.

The Dover Corporation Tramways.—The receipts for the week ending November 17th, 1900, were £170 11s. 11½d.; corresponding week last year, £159 8s. 0d.; increase, £11 3s. 11½d. Total to date, £9,600 3s. 7½d.; corresponding period last year, £9,149 19s. 11d.; increase, £450 3s. 8½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,947; 1899, 4,786. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending November 16th, 1900, were as follows:—D. U. T. Co., horse cars, £26 8s. 2d.; ditto, electric cars, £3,319 0s. 10d.; D. S. D. Co., electric cars, £667 11s. 6d.; total, £4,032 15s. 6d; corresponding week last year—D. U. T. Co., horse cars, £184 16s. 3d.; ditto, electric cars, £2,805 18s. 3d.; D. S. D. Co., electric cars, £699 19s. 6d.; total, £3,690 14s. 0d.; increase, £342 1s. 6d.; aggregate to date, £95,288 6s. 8d.; aggregate to date last year, £85,196 16s. 6d.; increase, £10,041 10s. 2d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 36 miles electrically, 8 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week erding November 18th, 1900, were £1,553; corresponding week last year, £1,438; increase, £115. Total from July 1st, 1900, £28,549; ditto corresponding period last year, £32,799; increase, £750. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

ALTHOUGH general expectation a week ago pointed to a rise in the Bank of England rate before Christmas, the threatened stringency would appear to be somewhat in the nature of a bogey, judging from the easing tendency of the Money Market. Capital becomes more easy to borrow every day, and this being the case, investment stocks and shares are benefiting all along the line. Consols and Government stocks, it is true, show little tendency to advance, the reason for their dalliance being the apprehension that is felt with regard to the issue of another heavy war loan after Parliament assembles next month. But the markets with which electrical undertakings are concerned, have already felt the genial influence of cheapening money, and there has been this week a fresh impetus given to the buying of high-class Debentures in the supply companies. We hear, for instance, of £3,000 Metropolitan Debenture, £3,500 St. James's Debenture, and other similar amounts being bought on a single day; large lines, these, for the limited market in which they were bought. The quotations are unchanged to outward appearance, but the prices are really better than they look, while the floating supply of stock is becoming exhausted.

As regards the prices of the Ordinary shares of the Electricity Supply undertakings, the principal feature is the comparative weakness of Metropolitans, after some strength had been displayed at the end of last week. The selling is due to the eternal squabble between the company and the Marylebone authorities, some of those who have been re-elected to office beginning to harass the Metropolitan Electric, as they vowed they would do last spring. Chelseas are a good market, the shares having quite recovered from the weakness they exhibited when the announcement of new Preferences was made. We may add that the new shares are all placed now, and that being so, it is not unlikely that a modest advance in the Ordinaries may take place. Charing Cross new Preferences are 5⅝, *i.e.*, 10s. premium on the issue price of 5½.

Marked flatness has developed in the market for the Eastern Telegraph descriptions. Eastern Ordinary stock is down 5, Eastern Extension shares 10s., which is equal to 5 per cent. The pre-Ordinary stocks of the parent company have also suffered, but "China" Debentures are maintained at 116½. Careful inquiries in the Stock Exchange go to show that the decline is attributable to the fact that a large seller of Eastern Ordinary came on the market early in the week. The buyers were shy, and the jobbers did not care to be saddled with a heavy amount of stock in times so quiet. Eastern Extensions were marked down in sympathy, and the restlessness spread even to Globe Telegraph and Trust shares, the Ordinary falling back 5s. On the other hand, a much more cheerful tone is still the distinguishing mark of Anglo-American descriptions. The Deferred ("A") stock reflects the feeling to the largest extent.

Western Telegraph shares are not so good, but it must be observed that the price is now *ex* bonus as well as dividend. The company's new Debenture stock is 102—105. West India and Panama shares are coming into favour again, and are nearly par. The Preferences, which may offer some margin for a rise, are unaltered. The market in them is a very narrow one.

The report of the British Westinghouse Company, lately out, has directed attention to the Preference shares of this concern, and helped them to strengthen to £5. From the document referred to, it would appear that the company is still in the running so far as tenders for electrifying the Metropolitan Railway are concerned. Another interesting report out this week is that of the Aron's Electricity Meter. The Ordinary shares are to have a dividend making 12 per cent. for the year, and the Preference will get an extra ½ per cent. over and above the 6 per cent. that is their legal due. Notwithstanding this, the Preference shares are no better than ¾—⅞.

Those of our readers who withdrew their applications for Baker Street and Waterloo Railway shares upon our hint last Friday will note with interest that the pre-allotment premium has now turned into a small discount.

The Rail and Tram Share Syndicate, Limited, of 69, King William Street, has been inundating investors with offers to purchase shares in four electric traction companies. This generous syndicate dates its offer "October, 1900"; most of the circulars reached their addresses on November 17th. It bids 13 for British Electric Traction shares; the shares are a mere 15s. higher on the market; the other bids were of the same description. Some ventures succeed in attaining their ends by sheer audacity, but we hope that the Rail and Tram Share Syndicate has now discovered that the system does not always pay.

Indefatigable as ever, the London United Tramways Company is promoting a Bill in Parliament whereby it seeks for powers to completely network the South-Western suburbs of the metropolis with light railways. No fewer than 19 new extensions are projected. The company evidently means to put into rapid use the money that it raised a fortnight ago by way of Debenture stock. The price of this stock in the market is quoted 3 to 5 premium.

National Telephone shares, after their slump, are picking up again, and the Ordinary have recovered to 4½. There are still a number of professional "bears" out of them, and the knowledge that this is so steadies the price considerably. Other telephone descriptions are marking time.

The electric railway market is irregular, Central Londons being good, while City and South Londons continue very weak. It is now stated that tenders for the electrifying of the Metropolitan Railway are to be opened on December 1st, but the announcement has produced no effect in the market.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Nov. 14th.	Closing Quotation November 21st.	Business done during week ended November 21st, 1900. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
822,700	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	53 — 56	53 — 56	55½	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	98 — 100	98 —100	100	98½
3,088,540	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10½— 11	10⅝— 11⅛	11	10⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	3 — 4	3 — 3½	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	165 —173½	165 —175	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —105	102 —104	103½	102½
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	6⅝	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10¼— 10⅝	10¼— 10⅝	10¼	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
3,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	148 —153	143 —148	149	147
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	97 —100	97	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	113 —118	112 —116	113½	112
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14⅜— 15½	14½— 14⅝	15	14 9/16
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) £3 pd.	10	...	...	...	6⅜— 7½	6½— 7	6 9/16	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	114 —119	114 —119	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99 —102%	99—102%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10½— 11	10½— 10⅝	10⅝	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15½	15⅛
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	32⅛	31½
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	49 — 53	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107	105½	105
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	¼— ⅜	¼— ⅛xd	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	⅝— 1	⅝— 1 xd	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	6 %	5 %	4⅛— 4⅜	4⅛— 4⅛	4⅛	4 7/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 —99	97½	96
500,000	Do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	101 —104	103	101⅜
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	125	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5⅛	4⅛— 5	4⅜	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	5 — 5⅛	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	... — ...	3½— 3⅝	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	100⅛	99⅜
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ¼	⅛— ¼	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Brss. Sub. Tel.	100	...	...	...	100 —103	100 —103	100½	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½— 14⅝	14 —14½	14⅝	14¼
75,000	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	⅜%	2 %	⅜%	⅜— ½	⅜— 1	1⅛	⅜
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	7	6½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	107	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	10½	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅞	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6 — 6½	6½— 6⅝	6 7/16	6½
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	10 %	6 %	4 %	8½— 9½	9 — 10	9 9/16	9½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 13½	13 — 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —111	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4⅝	4⅜
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅜— 2⅛	1⅜— 2⅛	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5⅛	4½— 5⅛	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13 — 14	13 — 14	13	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	113½	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	99	97¼
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15½	..
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	9	8⅞
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	... — ...	100 —103	101¼	100¾
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 —95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
70,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 —13	12 — 13	12½	12½

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation Nov. 14th.	Closing Quotation Nov. 21st.	Business done week ended Nov. 21st, 1900.	
		‡	1897.	1898.	1899.			Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	10	...	6 %	...	13½ — 14½	13½ — 14½	14⅜	14
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅝	12¼
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122	120¾
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜ — ½	7/16 — 9/16	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅜ — ¾	⅜ — ½	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
70,000	British Insulated Wire Ord.	5	15 %	15 %	20 %	10½ — 11½	10½ — 11½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝ — 1⅞	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	2 1/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	..	...	...	103 —105	103 —105	105	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	12½%	15 %	15 %	12½ — 13½	12½ — 13½	12⅞	12½
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅜	5
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10¾	10¼ — 10¾	10⅝	10⅜
78,703	Do. do. Pref. half-shares	5	...	...	...	5 — 5½	5 — 5½	5⅝	5 5/16
78,703	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5 5/16	5¼
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	54 — 58	54 — 58	54⅓	54
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4½ — 5½	4½ — 5½	5¼	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	...	6 %	7½%	3½ — 4	3½ — 4	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅜ — 2½	1⅜ — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½ — 4½	3½ — 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	...	...
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	96 —100	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜ — 3¼	2⅜ — 3¼	...	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	104⅜	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½ — 13½	12½ — 13½	13	12⅝
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼ — 5⅝	5¼ — 5⅝	5⅝	5⅜
50,000	Do. do. do. 4½ % Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21⅛	20¾
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	100—103	102½	102
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3⅜%	8 1/16 — 9 1/16	8 1/16 — 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	13 — 13¼	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 41	37 — 42	39½	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... *	...	...%	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5¼ — 5⅝	5¼ — 5⅝	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	92 — 95	92 — 95	93¾	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10¼.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6½—7½. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17⅞.

Bank rate of discount 4 per cent. (July 19th. 1900).

MARKET QUOTATIONS, Wednesday, November 21st.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	29/-	29/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to £145	£80 to £150	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) ..	per lb.	11½d.	11½d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£86	..

METALS, &c, *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£86	..
g ,, Rod	per ton	£86	£86	..
c ,, (Electrolytic) Bars ..	per ton	£88 10	£88 10	..
c ,, ,, Sheets ..	per ton	£92	£92	..
c ,, ,, Rod ..	per ton	£85 10	£85 10	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/11 to 4/1	3/11 to 4/1	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	64/7½	64/5	2½d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£11 15	£11 15	..
g Lead, English Ingot	per ton	£17 5 to £17 7 6	£17 15	dec.
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9 2 6	2s. 6d. dec
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 18	£3 18	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	£58	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£131 10 to £132 10	£131 to £132	10s. inc.
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6½d.	½d. dec.
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ord.)	per ton	£23 2 6	£23 2 6	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

INSTITUTION OF ELECTRICAL ENGINEERS.

INAUGURAL ADDRESS

By Prof. John Perry, M.E., D.Sc., F.R.S., President.

(*Concluded from page* 804.)

Remember that I do not now refer to the few exceptional heaven-born engineers who, in spite of bad training, do manage somehow to pick up the necessary knowledge. I speak of the average men, many of whom are now living in the same old fool's paradise. They know enough for present needs; they scorn the simple principles which underlie all our work; they scorn the easy mathematics by which these principles are most readily employed in practical problems. They will have their reward.

Just think of what is occurring at the present time. In England we have cheap coal, and it can be carried easily. In Switzerland and other countries where there is no cheap coal the water-power had to be utilised and power had to be transmitted great distances electrically. This needed high voltage, and as it is difficult to get high voltage with direct current machines, alternating currents were used, and on account of motor troubles multiphase working has been introduced. What a revelation it was to almost all of us, that visit of a year ago to Switzerland! We saw enormous schemes of lighting and traction and power. We saw electric trains driven by distant waterfalls sandwiched in among ordinary trains keeping proper time on working railways. We had known that there were great schemes carried out in Germany and America and other countries, and yet all the machines were quite unfamiliar to us. We were very much like what engineers of 1870 would have been if suddenly brought into a generating station. Is it not a fact that some of us, said to be eminent and thought to be practical, asked questions and made remarks which showed that we did not know the most elementary principles of three-phase working. Is it then any wonder that the traction schemes now being developed in England, on lines that are certainly not the best for this country of their adoption, are altogether dependent on the use of foreign electrical machinery and employ foreign electrical engineers? I am not putting this altogether fairly, for municipal procrastination has prevented our development, and yet I am not putting it altogether unfairly. We know too little theory.

I am afraid that just now we are in a rather tight place. I would give something to know how we in this room are going to get acquainted with modern electrical engineering. Our usual way of learning is by actual handling of things. But if the millions of pounds' worth of machinery coming to England every year is all foreign and is used mainly under foreign superintendence, our usual method of study is made very difficult. True there are American and German, and indeed English publications which would give a knowledge of the theory, but not, I think, to the average English electrical engineer. I know of many men 25 to 40 years of age who seldom come to our meetings, and who say they are silent in discussions because they cannot be understood; perhaps these men will find a way to save us all from being left behind. There is much more that I might say in this connection. An individual Englishman may be left behind other Englishmen, and all English electrical engineers may be left behind the rest of the world, but all electrical engineers of the world may even be left behind other appliers of science. It is not merely that the incandescent mantle of the gas engineer is improving and necessitates improvements in our filaments, but in spite of the flourishing conditions of our factories just now, I could give many other illustrations of how we shall all suffer if we do not keep adding to our knowledge. Twenty years ago, when giving some lectures in Clerkenwell to workers in the then flourishing watch trade, I ventured to prophesy the decay of that trade. But I am afraid that the case of Jonah and Nineveh is the only one in which prediction of disaster led to reform. I venture on no prophesy therefore, because it might harden your hearts.

Much of the evil we suffer from is due to our average young men being pitchforked into works where they get no instruction as soon as they leave school. If ordinary school education were worth the name, and if schoolmasters could be brought to see that we do not live in the fifteenth century, if boys were really taught to think for themselves through common-sense training in natural science, things would not be so bad. But the average boy leaves an English school with no power to think for himself, and with less than no knowledge of natural science, and he learns what is called mathematics in such a fashion that he hates the sight of a mathematical expression all his life after.

And what is the result? English engineers do make a wonderfully intimate acquaintance with the machines and tools that they work with, but when it comes to the manufacture of new things they do it by fitting and trying, by quite unnecessary expenditure of money, through trial and error. A machine is made and tried, and then another better one, until a good result is arrived at. And this method did well enough in the past, and would do well enough in the future, if only we had not to compete with foreigners who can really calculate. It is not all smoke; there is a real danger in this foreign competition unless we mend our ways. There is an absolute necessity for great change in English ways; but there are so many people interested in the maintenance of old methods of working; so many people who think they will lose their bread and butter if a change takes place; so much capital, scholastic and other, invested in our old machinery, that it takes a catastrophe to produce changes. Much of the strength and weakness of England has always lain in her conservatism. We have been talking of standardisation of machinery lately, so I may say that things have been standardised in England for a long time. Now, to get all the good effect of standardisation, it is occasionally necessary to go in for wholesale scrapping, and it is this scrapping part of the business that we dislike in England. We here all know that the District and Metropolitan Railways might have been worked electrically years ago, just as easily as they will be when we are allowed to begin upon them, but, of course, the scrapping of a lot of steam locomotives was a serious thing. The loss of experience to English electrical engineers, because of this hatred of scrapping, is leading to other incalculable losses. I understand that the whole generating and line plant—the whole machinery of the Boston tramways—has been scrapped several times since they first were driven electrically. Japan has scrapped all her old civilisation, just as France did. During the century now dying, Germany has made the most sweeping changes in her law and school legislation, and, indeed, in everything. England and Spain and China, how they differ in this respect, even from England's own colonies.

Of course it may be said that English customs have grown during centuries; they are well tried, and there is no pressing need for sudden alteration. I quite agree, but unfortunately this very perfection and fitness of our customs have bred in us a want of flexibility, so that in cases where a sudden change is really necessary, we are disinclined to make the change merely because it is a change and for no other reason.

No one has ever heard me speak of the decadence of England. When the greatness and the wealth, the manliness and the strength, the healthiness and good life of England are shown forth to the as yet ignorant world in all their magnitude there will be some astonishment. But it is our duty to keep up our high standards. We must change what is bad when we know it to be bad, and not let bad things* continue to exist, parasitic growths, maintained because on the whole we are strong and healthy. You will perhaps think that this is a very serious exordium when I tell you that I have introduced it all on account of the state of mathematics in our profession. I feel a sort of degradation every time that I hear a successful, clever old member of this Institution sneering at mathematics. There is a plausibility about his statements; he himself has been very successful in life without much help from mathematics; but indeed his sneer is doing a great deal of harm to the younger members who admire his success, who forget that he has succeeded in spite of, and not because of, his neglect of mathematics.

Our knowledge of electrical phenomena must be quantitative to be of practical use; we must be able to calculate. Mathematics is the science of calculation, and we must therefore be able to employ, and we all do necessarily employ, less or more mathematics every hour of our professional lives. The draper and the grocer and the housekeeper merely need arithmetic. Everybody now knows some arithmetic. Everybody can add and substract and multiply and divide, and keep accounts in some simple sort of way. This is due to the fact that arithmetic is no longer taught in the old Greek method with its 27 independent characters (for our 10 figures), the study of which required a lifetime, so that only old men could do multiplication, and they not only needed many hours to do one easy bit of multiplication, but declared that if the art were not practised every day it could not be remembered. Reading and writing and ciphering are now taught to everybody. It used to be that only learned men and philosophers could read, write and compute. You will remember the charge that was brought against one of Shakespeare's characters, who was said to possess mere bookish theory without practical knowledge. "And what was he" "Forsooth a great arithmetician." Nowadays, when everybody can compute, we should say of the possessor of mere bookish theory, "Forsooth he knows the calculus."

For in mediæval times things were taught in such a way that only a few men had a chance of knowing how to read, write, and cipher. We have been compelled to change all that, the pedagogue has by compulsion given up his mediæval methods of teaching in these things, although in all other matters he retains them. But a time has come when we see that ciphering is not enough mathematics for us to be familiar with, we need a little algebra, we need co-ordinate geometry, we need the differential and integral calculus. The pedagogue tells us that we must follow the orthodox course of study, which takes many years; and some of us, many of us, who have followed the orthodox method find that we have spent so much time and mental power upon it and its thousands of unnecessary tricks and contrivances and philosophy, that we can take in no more ideas. We cannot utilise our mathematics on engineering problems because we are too old and tired and *blasé* to comprehend these problems. Nevertheless we are the only people who know mathematics, and so we publish volumes of unmeaning and useless disquisitions on problems that we do not understand. Or we know just enough mathematics to be able to show our ignorance to experts, but quite enough to impress engineers with our knowledge; and we know just enough about engineering problems to show our ignorance to engineers, but quite enough to impress mathematicians, and what we publish is merely as the crackling of thorns under a pot.

As for the man who does understand electrical problems, he remembers that there was a something called a study of mathematics at his school, that he did pass certain examinations with

* Such as our wretched system of weights and measures. Oh, young America and Australia, is it wise to waste a year of every child's life, and years of the life of every business man, merely because we do it in England? You get many of your pedagogues from us, and of course they say that without cwts., qrs., and lbs., and Latin declensions, and Euclid, the mind cannot be trained. Do you believe them, or are you with open eyes making a great sentimental sacrifice?

(e Messrs. Frederick Smith & Co. (f Messrs. Henry C. Yeo & Co. (g The Phosphor Bronze Company, Ltd.

much difficulty and tribulation, that the subject had no real meaning to him even when he was supposed to know it, and he now hates the sight of anything that looks like mathematics.

I tell you, gentlemen, that there is only one remedy for this sort of thing. Just as the antiquated method of studying arithmetic has been given up, so the antiquated method of studying other parts of mathematics must be given up. The practical engineer needs to use squared paper. What is the use of telling him that he has taken an unauthorised way to the study of co-ordinate geometry, that he cannot approach it except through Euclid and modern geometry and geometrical conics and algebra and trigonometry. He says the youngest child can be made to understand diagrams on squared paper.

So, again, the idea underlying the calculus is one that every child, every boy, every man possesses and uses every day of his life, and there are useful methods of the calculus that might be taught quite quickly to boys, and which it would be a pleasure to boys and men to use continually in all sorts of practical problems, but, of course, the subject of the differential and integral calculus is one that must come at the end of a long course of what is, to the average boy, utterly uninteresting and unmeaning mathematics. Indeed, the average boy never reaches the subject, whose very names, differential and integral calculus, are enough to drive him frantic.

Yes, the schoolmasters say that we must follow the mediæval rules of the game, and all sorts of fine things are said about them, but as a matter of fact we only need to bring a little common sense to bear upon schoolmasters. At present most of us stick to our arithmetic as a safe and well-tried friend. We compute after the manner of the draper and grocer and housekeeper. In finding out what is the best size of conductor, or armature winding or core, or iron and winding of a field magnet, we calculate by mere arithmetic for one size and then for another; perhaps we have weeks of arithmetical computation before we find the right size of thing to use, and we cannot frame general rules. And some foolish person who knows a little mathematics, works at the problem (as we ought to be able to do but are not) and he frames a general rule and we laugh at it, and sneer at mathematics because he has probably left out of account the most important consideration. We know that the result is wrong, but we cannot say why it is wrong.

Then there are some far-reaching, labour-saving ideas that we simply cannot get into our heads at all—we cannot comprehend them. Am I sinning against the rule as to good comradeship which exists here, if I say that some of us are ignorant of the most fundamental fact regulating economy in arranging sizes of conductors? Suppose we find the total cost of installing a conductor of a certain length, using 1 square inch section of copper. We do the same thing for other sizes, and we plot total cost and weight of mere copper on squared paper. I do not care what system we adopt, if it is the same system for all sizes, and if we buy our materials from the same manufacturers, and use the same kind of labour, our points will lie very nearly in a straight line on the squared paper. Hence increased cost will be proportioned to increased weight of copper, and, indeed, increased total cost will be like the mere increase in the cost of copper, taking a slightly higher price of copper per ton. Some of us, ignorant of the elementary mathematics involved in the problem, think that the mistake has been made of assuming that the cost of an installed conductor is merely the cost of the copper in it, and, of course, he must feel that it is too absurd a mistake not to be laughed over. With an elementary knowledge of mathematics his mistake would be impossible, and without such a knowledge, the clever electrical engineer is constantly discovering mare's nests in the investigations which he criticises.

I know of long misleading accounts of the results of good experimental observations, which might have been described in a few clear words by the aid of elementary mathematics. I know men who spend, on a particular problem, 10 times the amount of worrying thought that would enable them to master the easy mathematics that includes all such problems. Quite recently one of our most eminent members declared to me that he had not really grasped the reason for small economy at a power station when there is a small load factor until he studied the common-sense mathematical form which has been given in a recent publication. And yet he is a man who has heard much, and read much, and talked much on this subject.

Every electrical engineer has a correct idea of how a transformer acts, or how the E.M.F. in one of the coils of an armature of a direct current or other generator, or, let us say, a rotary transformer, changes during a revolution, and how the E.M.Fs. of all the coils are combined to produce currents in the external circuits. But through how much mathematical tribulation must most of us have passed from our state of ignorance to our present state of knowledge! It is no wonder that we are disinclined to the study of a new phenomenon which seems as if it might lead us through the like tribulation. The tribulation is least because it is suffered only once if we first learn the Calculus method which underlies all our work; it is greatest if we get it up in a completely new-looking form in every new problem. I speak now of what is most difficult in our study, for there is thought required in applying the Calculus method. Thus, for example, in multiphase work at the present time the best mathematicians wonder how it is possible for easy calculation to be made in such a subject. What we want just now is that an electrical engineer acquainted with three-phase current phenomena should be so much a master of ordinary easy mathematics that he has a chance of discovering a very simple way of putting the matter before us. At present calculation is easy but tedious, and, indeed, repellant; but I am perfectly certain that a competent man might quickly invent methods of calculation which are not only easy, but short and thinkable. Mathematicians with the requisite electrical knowledge, again, may be lacking in sympathy and humour. I know a book of more than 300 large pages on ordinary alternating currents, and all the information in it is given far more simply in two pages of another book with which some of you are acquainted. Possibly, just now, mathematicians who are electrical and who have common sense have too much other work to do, and we must wait their leisure.

The fact is, mathematics ought to be the natural language of the electrical engineer, and at present it is a foreign language; we cannot read or write or think in it. We are at the beginning of our development, like monkeys whose necessities have increased faster than their power of speech.

Some of you are aware that a new method of teaching mathematics has recently been introduced in nearly all the evening classes in science schools throughout the country.* I wish I could say that there was a prospect of its being introduced in all schools, for it seems to me that this would lead to the result that all young men entering works would be masters of that kind of calculation which is most important in electrical engineering; not merely a few men having this power, but the average men, just as average men can read and write.

I am addressing engineers, men who utilise the results arrived at by scientific workers, men whose profession is applied science. But surely if we are to apply the results arrived at by scientific men, if the laboratory experiment of to-day is the engineering achievement of to-morrow, we ought to be very much alive to all that is going on in the scientific world.

All men ought to be far more alive to the importance of scientific work. On the psychological side, it is perfectly exasperating to me to see how few are the men who know that Darwin has given a key to almost all the great philosophical problems of antiquity, and that there is a great mental development accompanying the more evident engineering development now going on in the world. Again it is the fault of our methods of education that all our great men, our most important, most brilliant, best educated men, our poets and novelists, our legislators and lawyers, our soldiers and sailors, our great manufacturers and merchants, our clergymen and schoolmasters, should remain so ignorant of physical science, the application of which by a few men not ignorant is transforming all the conditions of civilisation.† But of all men just think what it means for engineers to be ignorant of science, or neglectful of its new developments, and of all engineers think what it would mean if electrical engineers sinned in this way.

Except ours, all other branches of industry have taken thousands of years to grow. There were bridge and hydraulic and sanitary and harbour and river engineers in ancient Rome, and such engineers existed thousands of years before the first papyrus was written in Egypt. But no Assyrian tile or Egyptian hieroglyphic or relic from a tomb indicates that telephones or electric motors or electric lights existed before our time. No gradual improvement in our methods of conquering nature led up from small beginnings in our electrical engineering. Our profession has not grown during thousands of years of time like other professions. It has sprung suddenly, full grown, from the new spirit which is going to rule the souls and bodies of men, the spirit of research in pure science. The new spirit puts knowledge, mere knowledge of nature, as its highest aim. The scientific student knows that all sorts of good must come to mankind from his studies; all sorts of scientific knowledge are sure to be utilised by engineers, but in the pursuit of science the usefulness and utility of the result are of no importance. And are we—we who have received the first-fruits of the labours of scientific men, we the first-born spoilt children of the great parent of all that is to come, we who form the foremost files of the present time—are we going to turn upon our beautiful young mother and say she is useless and ugly, and she hinders our money-making, and that we are willing to kill her for the sake of the burial fee? Thank God that is the spirit of only a few of us. Have we not as an Institution gone to great expense in the publication of *Science Abstracts* in partnership with the Physical Society. That publication has been and continues to be of the very greatest value to all students of pure and applied science who read our language, for it tells them the results of all the scientific work now being done in all parts of the world. And even if some of us do not read that useful publication, do we not know that it is there to read if we like? Do we not know that it is a symbol of our redemption from the yoke of the Philistine? It is one of many signs that, in answer to the question which I have asked in this address, we can truthfully say that we are professional men, that our profession has promise of enormous expansion and improvement, and that we are not mere tradesmen.

I am afraid that you will think that I have a personal interest in putting before you the claims for consideration of the pursuit of pure science, because you know that I am trying to defend Kew Observatory from imminent danger. In truth, I have no interest in this matter unbecoming a president of this Institution. For two years I have been trying to reason with traction engineers. Like many other electrical engineers, these gentlemen desire to use uninsulated return conductors. If they do so near a magnetic observatory certain records of terrestrial magnetic disturbances are quite spoilt. At Potsdam this sacrilege has been forbidden. At Washington, Toronto, Capetown, and most other important places, the magnetic records have already been rendered

* See summary of Lectures on Practical Mathematics; also the Science and Art Directory and the Reports of Examiners on the Science Examinations of 1899 and 1900, all published by the Education Department, South Kensington, S.W. The forms now advocated in mathematical and science teaching are all clearly described in a paper read before the Society of Arts in January, 1880.

† See articles in *Nature* of July 5th and August 2nd.

useless. Prof. Rücker and I were asked by the other members of the Committee of the Royal Society which was in charge of the Kew Observatory to defend Kew, and with the help of Her Majesty's Treasury, we thought we were able to insist upon the use of insulated returns in all undertakings authorised by Parliament where harm was likely to be inflicted on Government observatories. I may say that the scheme designed by Mr. Clifton Robinson for using an insulated return conductor in the working of the tramways of the London United Tramways Company, in consequence of our action, was a thoroughly good scheme, which it gave one satisfaction to look at, not ugly and not expensive. It seemed to me a fit scheme for any tramway system, however complex, in which overhead conductors are used. You are aware that for an electric railway or for a tramway where a conduit is employed, it is in every way better, and is in a large scheme actually cheaper to use an insulated return. We felt, therefore, very happy, for magnetic observatories seemed quite safe from interference. We were, however, mistaken, for the only clause which we have been able to get inserted in all Parliamentary authorisations of undertakings, leaves it to the Board of Trade to substitute other methods of protection than the insulation of the return conductors in cases where these other methods seem to be sufficiently good for the protection of laboratories and observatories, and this is why the Board of Trade appointed the committee which met on October 31st, probably for the last time.

Prof. Rücker, Prof. Ayrton, and I have made many tests on the magnetic disturbances produced by tramways and railways, particularly by the Stockton tramways and by the Waterloo and City Railway, and we have had many meetings with the traction engineers, but nothing has yet been decided.

I mention this matter, which has given great anxiety to scientific men, because I am afraid that some of you may think when you hear of it that I have been acting against the interests of the electrical industry. I beg to assure you that I have been acting in your best interests. As an electrical engineer I ought surely to regret the use of uninsulated returns even if we leave Kew Observatory out of account. Suppose we do not now insulate our returns. Electricity will certainly return by gas and water pipes, and the amount of harm done to those pipes is merely a question of time. Because of the ignorance of legislators and gas and water companies, nothing is said just now, but will nothing be said at the end of 10 or 20 years when pipes are found to be eaten away everywhere? And if by a slight increase of expense, or rather, as I think, actually no increase of expense, but merely a little increase in inventiveness and common sense on the part of electrical engineers, this evil may be entirely prevented, surely it is in the interests of all of us that insulated returns should be insisted upon. But even if we do not insist on insulating the returns in all systems, surely something may be said for the giving of this protection on lines near such a magnetic observatory as Kew. Even the magnetograph records now being made have been continuous for 45 years, and if Kew is interfered with no sum of money can compensate for the interference; for if the Observatory were removed the future observations would have no link with the past.

An engineer in this room declared that it seemed to him an injustice to hamper the progress of electric tramways "for the sake of making observations that never have given, and never may give, to the world any important results." Now, it is not so much on account of Kew that I object to this sort of observation, as to its general spirit of antagonism to scientific research.

There is no doubt that the answer to the old question which Gilbert might have asked 300 years ago, "What is the cause of terrestrial magnetism?" is very jealously hidden from us by Nature. The earth probably contains much iron, but its great internal heat seems to forbid our imagining the iron to be magnetic. The assumption that a negative electric charge on the rotating earth will explain things, requires such an enormous charge that this assumption has been discarded. There are annual and diurnal variations of a fairly regular kind; there are storms which have some relation to the Aurora Borealis, to sun-spots and to earth currents. There are small sudden changes which seem to occur almost instantaneously all over the earth. Observations of these things may be useless from some points of view, but scientific men have been and continue to be willing to give up time and much money for this object. Utilitarians had to be cajoled through superstition to allow observations of the stars to be carried on in ancient times, and we have no such cajolery to offer. We simply say that it has been through this sort of useless-looking method of working that all our progress in science has come.

Engineers descended from men who sneered at Cavendish and Franklin and Volta and Oersted and Ohm and Faraday, are you who utilise the results of the work so sneered at, and pile up fortunes in consequence of it, are you the men to sneer at and ridicule the scientific work of the present day because it seems to you useless?

Tell us a better method of observation; give us better suggestions as to what these magnetic phenomena may mean; but the past record of scientific observation enables us to laugh at you when you say that magnetic observations may never give the world any important results. Was Nature ever so open, and yet so closed about a secret as she is about this one of terrestrial magnetism? Was there ever one whose revelation promised so much? How very little we know of electricity and magnetism! Does the mere motion of the earth, taking no account of electric charges at all, cause it to be magnetic? Almost anything is on the cards. Surely I need not appeal to your cupidity, but it is quite possible that our knowledge of this secret may enable us to tap a tremendous store of Nature's energy.

Gentlemen, this is not a trades union, and it is not a society for the furtherance of pure scientific research, but it is a society of professional men who recognise the past services of scientific observers with gratitude and respect, and hope for greater ones in the future. And shall it be said of us that our gratitude is not greater than that of Judas, to whom, indeed, 30 pieces of silver was doubtless a large sum; that "we have given our hearts away a sordid boon;" and that as to our future hopes we are willing to sell our birthright for a mess of pottage.

TRAMWAY WORKING COSTS ON THE LEEDS CITY TRAMWAYS

The following return shows the receipts and working expenses o electric, steam, and horse cars for the year ended March 25th, 1900:

ELECTRIC TRAMWAYS.

Total electric car receipts ...	£63,436 10 5
Total mileage	1,205,812 miles.
Receipts per mile	12·62d.
Working expenses	5·97d.

Analysis of Working Expenses.

	£	s.	d.	Expenses per mile.
Drivers' wages	5,657	8	7	1·12d.
Conductors' wages	4,124	6	11	·82d.
Generating station expenses—	£	s.	d.	
Depôt men's wages ...	1,130	7	11	
Oil	155	13	6	
Coal	2,374	12	0	
Sundries	343	7	10	
	£4,003	1	3	
Less amount from Lamp Committee	456	5	0	
	3,547	16	3	·75d.
Battery station expenses	89	2	9	·01d.
Electric car shed expenses—				
Materials for repairs and car maintenance	2,427	17	9	·48d.
Wages of car washers and depôt men ...	3,284	13	2	·65d.
Depreciation on motor and trailer cars ...	2,349	10	6	·46d.
Electrical engineers' salaries	614	7	7	·12d.
Road maintenance (proportion)	3,000	0	0	·60d.
Compensation, damage, and personal injuries	630	15	3	·12d.
Management and general expenses (as per detailed statement appended)	4,145	17	8	·82d.
Office rents (proportion)	73	14	11	·01d.
Payments to Army Reservists' wives ...	51	2	2	·01d.
Repairs to Kirkstall depôt (half)	44	9	10	·00d.
Total expenses ...	£30,041	3	4	5·97d.*
Cost of generating current, per Board of Trade unit ...				·82d.

(* This does not include interest on capital and sinking fund, or depreciation on electrical plant other than cars.)

Total Miles Run by Electric and Trailer Cars.

Motors	1,052,444
Trailers	153,368
Total miles ...	1,205,812

The consumption of current, per motor car mile, is ... ·917 unit.
The consumption of current for each trailer car mile is ·458 unit.

Details of Mileage.

Motor cars	1,052,444
Trailer cars (mileage taken as half) ...	76,684*
Total miles at ·917 unit per mile	1,129,128

(*Halve the trailer mileage and add to the motor mileage, and reckon the total at ·917 unit per mile.)

Total generating station expenses, £3,547 16s. 3d. = ·75d. per mile.

Number of Units Generated for Year ended March 25th, 1900.

Total units	1,095,231
Less supplied to arc lamps, shed-lighting, &c.	59,682
	1,035,549

Total cost, £3,547 16s. 3d.

STEAM TRAMWAYS.

Steam car receipts	£23,697 5 10
Total mileage	468,760 miles.
Receipts per mile	12·13d.

Analysis of Working Expenses.

	£	s.	d.	Expenses per mile.
Repairs	5,253	10	5	2·69d.
Fuel	3,278	16	2	1·67d.
Drivers' wages	2,810	5	4	1·43d.
Conductors' wages	2,226	14	7	1·14d.
Rent of offices (proportion)	75	9	2	·03d.
Engine boiler insurance	57	9	3	·02d.
Compensation—Damage and personal injuries	186	15	6	·09d.
Maintenance of roads (proportion)	1,000	0	0	·51d.
Do. cars do. (half)	2,220	10	0	1·13d.
Depreciation on cars do. (half)	638	10	0	·32d.
Do. engines	1,350	0	0	·69d.
Management and general expenses	4,145	17	8	2·12d.
Repairs to Kirkstall depôt (half)	44	9	10	·02d.
Total expenses	£23,288	7	11	11·90d.*

(* Exclusive of interest on capital or sinking fund charges.)

HORSE TRAMWAYS.

Horse car receipts	£39,522 10 1
Total mileage	990,182 miles.
Receipts per mile	9·57d.

Analysis of Working Expenses.

	£	s.	d.	Expenses per mile.
Horse keep—Corn, hay, and bran	14,072	10	5	3·41d.
Bedding	632	5	2	·15d.
Wages	4,913	12	2	1·19d.
Utensils and sundries	411	6	3	·09d.
Horse shoeing and veterinary services	1,660	10	9	·40d.
Drivers' wages	5,226	13	2	1·26d.
Conductors' wages	4,357	7	6	1·05d.
Foremen and tip-boys' wages	1,429	14	10	·34d.
Rent of stables and offices	447	9	2	·10d.
General repairs to depôts, &c.	471	12	10	·11d.
Gas and water	489	1	6	·11d.
Compensation—Damage and personal injuries	54	5	6	·01d.
Maintenance of roads (proportion)	345	12	4	·08d.
Do. cars do.	2,220	10	0	·53d.
Do. harness	342	5	11	·08d.
Depreciation on cars	638	10	0	·15d.
Management & general expenses (proportion)	4,145	17	8	1·00d.
Horse renewal account	2,957	10	0	·71d.
Total expenses	£44,816	15	2	10·77d.*

(* Exclusive of interest on capital or sinking fund charges.)

Details of Management and General Expenses.

	£	s.	d.
Rates	2,631	1	9
Licences	181	19	6
Insurance (Buildings)	105	16	1
Insurance (Workmen's)	236	18	9
Taxes (Income)	664	2	9
Salaries (Office)	2,181	19	3
Salt, gravel, &c.	1,936	10	11
Printing, stationery, and advertising	434	17	9
Cost of telephone service	74	13	2
Drivers' and conductors' uniforms	897	7	4
Inspectors', &c., wages	2,998	4	11
Electric light	94	0	10
Total for whole system	£12,437	13	0
Proportion (⅓) to horse, steam, and electric	£4,145	17	8

	£	s.	d.
Proportion of rents—Horse haulage	447	9	2
Do. Steam do.	75	9	2
Do. Electric do.	73	14	11
	£596	13	3

	£	s.	d.
Repairs to Headingley Cottages	23	0	2
Repairs, general	448	12	8
Gas and water	489	1	6
	£960	14	4

THE BALANCE OF TRADE IN ENGINEERING.

Our esteemed contemporary, the *Street Railway Journal* of America, in its last issue dealt with the position occupied by various countries in electrical engineering. At the outset, we would observe that there is steadily growing amongst manufacturers in this country a great feeling of discontent as to the unfair conditions under which the English manufacturer competes with the rest of the world. In other words, many openly and boldly question whether free trade after all is so good a thing as it appeared to be 30 years ago. One can quite understand manufacturers who export their products to foreign countries being somewhat resentful at having to pay heavy duties upon goods which they know can be shipped by foreign makers into this country without paying a farthing duty. Moreover, the senseless system adopted in foreign countries by which the gross weight is subject to duty naturally makes an exporter somewhat discontented.

To take an instance, if a paper maker sends his products abroad he is not charged on the exact weight of paper, but has to pay duty also on the wooden case or iron hoops or whatever packing is employed. Such a system hardly encourages substantial packing.

To return, however, to our own particular industry, our contemporary observes that for the past 15 years engineers on both sides of the Atlantic have been busily engaged in working up apparatus for electric lighting, traction, and power transmission. There has been a marked tendency in electrical engineering for methods and systems to shift backwards and forwards from one country to another. The system of direct-connected engines and dynamos was brought to its highest pitch of excellence in this country, while our friends on the other side multiplied their stations and used belt-driven plant to a very great extent, but with the development of multipolar dynamos came low speed; this gave the Americans an opportunity of taking up direct coupled sets, and they were not slow to develop this particular type of electrical machinery. But in estimating the value of the practice in the two countries, it should not be forgotten that the great development of electric lighting in this country was based on high-speed direct-coupled plant, and in this respect English practice has always differed from that of the United States. There is no doubt that the large multipolar machine, as made in America, is a very excellent piece of work, but while some Americans have been somewhat inclined to sneer at the multipolar machine designed in this country, it should not be forgotten that it is much more difficult to build the armature of a multipolar machine for high speed working than for low speed, and we do not think that the best of our American friends would have done a great deal better than some of the English manufacturers. Our contemporary observes that at the present time Americans lead the world in the building of colossal direct-connecting generating sets, while the more conservative engineers abroad are still clinging to belt and rope-driven apparatus. We need hardly observe that this statement is entirely without basis as regards this country, and probably is not intended to apply to it. We would not for a moment grudge credit to American engineers, and we can add our tribute to that of our contemporary in complimenting the Americans on their developments in polyphase apparatus.

Both in the induction motor and in the rotary converter the Americans have taught electrical engineers some very valuable lessons; but again we would observe that the conditions obtaining on the other side lend themselves to the development of such machinery; there has certainly not been the same opportunity for utilising this apparatus in England as has prevailed in other countries. Our contemporary mentions that the initiation and development of engineering methods abroad have not met a prompt response in America; and only slowly and even grudingly have other improvements been recognised, whether the original invention was American or foreign.

It gives as an example of this the slotted conduit tramway, which has been developed to a considerable extent in Europe, but we are not inclined to agree when it says that polyphase motors have been taken up and have become one of the recognised methods for operating railways of the suburban types. There are some excellent examples of polyphase tramways in Europe, but there are not half-a-dozen systems in operation. As an example of a practice which has become almost the standard in Europe, our contemporary instances the grooved rail, which American engineers have not liked, nor do they like to-day, but yet it has forced itself into widespread use. It is by no means an easy task to estimate the value of the work contributed by any country in electrical engineering. It goes without saying that one country can learn much from another; but though various systems and details have been and will be transported from one place to the other, it may be accepted generally that the conditions of a country determine to a very great extent not only the particular systems but the types of plant. There is one remarkable instance where the Americans have taken advantage of what has been done in this country. We refer to the use of accumulators. Some of the very earliest electric lighting works erected in this country were considered incomplete unless they had a battery of accumulators. They frequently gave no end of trouble, but in spite of mechanical defects and comparative inefficiency, it was recognised by central station authorities that a battery rendered the very greatest service in meeting the peculiar conditions that surrounded an electricity supply system. Engineers on the other side were extremely chary of adopting accumulators, but the persistent way in which they were used in this country apparently convinced them that some advantage must attach to their use, and eventually they made their appearance in two or three American systems; they have since increased in number at a most astonishing rate. When Americans take up a subject they do so with a vigour and a thoroughness that is almost startling to the cautious Englishman. We have at times lamented the somewhat slow progress made in this country, but it has not always been the fault of the engineer; legislative obstacles and the niggardly support of the capitalist have been mainly responsible for the unfavourable position we occupy in electrical engineering.

APPARATUS FOR THE DETECTION AND REGISTRATION OF ELECTRICAL VIBRATIONS.*

By A. C. POPOFF.

The contents of the present paper, in its main features, formed the subject of a communication at the April meeting of the Physical Section of our Society. This communication is now supplemented with the results of experiments with my apparatus, carried out at the Institute of Forestry by Mr. A. Luboslavsky, together with certain experiments made with the object of elucidating the phenomenon on which the arrangement of the apparatus is based, and the conditions of working of the apparatus.

At the beginning of the present year I was engaged in the reproduction of certain experiments of Lodge † on electrical vibrations, with the view of performing them at my lectures, but the first trial showed me that the phenomenon underlying the experiments—the amount of resistance offered by the metal filings under the influence of electric vibrations—was very variable. In order to reproduce the effects it was necessary to try various combinations. Finally I arrived at a form of apparatus for the observation of electric vibrations which is suitable both for lecture purposes and for recording the electrical disturbances which occur in the atmosphere. At the same time I made a few experiments with the object of throwing light on the fundamental phenomenon, but I should explain that this in itself was not the object of my investigations.

In the year 1891 Branly discovered that thin films of metal spread over glass, ebonite, &c., and also metallic powders, possess the power of instantaneously changing their resistance to electric currents, if discharges from electric machines or induction coils take place in their neighbourhood.

Not so markedly, but yet sensibly, the resistance of the powder varies if a current from a large number of cells be momentarily passed over it. The resistance under the influence of discharges generally decreases, although there are exceptions; a thin film of platinum (platinised glass) sometimes increases in resistance.‡ These properties of the powder are maintained if it be placed in a non-conducting liquid, such as Canadian balsam (Branly) or even in such nearly dry media as collodion and gelatine (Minchin),§ or in gutta-percha (Appleyard),‖ mechanical vibrations restore the particles to their previous condition of high conductivity.

Minchin, and afterwards Lodge, applied these properties of metallic powders to the detection of Hertzian rays,¶ and Bernadsky ** has recently described experiments closely resembling those of Hertz.

As to the cause of the phenomenon, Branly supposes at the moment of the discharge all the particles of the powder lying in close proximity to each other, but without actually touching, become charged like condensers, and by reason of their mutual attraction, approach each other, and make better contact.

In fact, the diminution of resistance, due to electric vibrations, is of that kind and degree which may be produced in the powder by pressure. Minchin, assuming that in his experiments the mobility of individual particles was decreased, and their sensitiveness diminished by the drying up of the gelatine, explains the diminution of resistance by molecular movement, by the changes in the arrangement of the molecules subjected to electro-magnetic disturbances.

Lodge having in view the previously-known facts that the separate drops in a jet of liquid, and even those in neighbouring jets, unite with each other†† under the influence of weak electric forces, and having regard to the analogous phenomenon of the dissipation of fog and smoke by electrification, believes that it is possible to explain in a similar way the diminution of the resistance of powders under the action of electric forces. Lodge supposes that adjacent particles when, in addition to molecular attraction between them, they are acted upon by electric force, definitely unite with each other, and give rise to the phenomenon which, in physics, is designated by the word "cohesion." Subsequently, in his lecture on the "Work of Hertz," he used, among others, the phrase "it is a singular variety of electric welding" to characterise the electric mechanism of the phenomenon, that is, he compares the connection formed in the powder to an electric weld. For my part, I agree with the latter view of Lodge, attaching, however, greater importance to the word "weld" than he does.

I understand more especially by the word "weld" (svarivanie) the possible formation in the powder of continuous metallic filaments along the lines in which the discharge takes place, so that the power of different metals to weld, understood in the literal sense, consists in a certain correlation depending on the sensitiveness of the powders, as will be evident from the experiments about to be described.

I first of all desired to give such a form to the coherer that it might have practically constant sensitiveness. To do this, in accordance with the above views of the phenomenon, it is necessary to try such an arrangement of the parts of the circuit containing the filings, as would increase the chances of an arrangement of the metallic filaments in the direction of the current. The best results were obtained with the following combinations:—

1. Inside a glass tube, about 7 centimetres long, and 1 centimetre in diameter, are stretched two parallel wires passing through corks, and so arranged as not to touch each other. The filings are so disposed in the tube as to only partially fill it. This form of coherer is very suitable for experiments with an insensitive galvanometer and discharges from an electric machine. The amount of resistance can be regulated by sloping the tube, so that in the vertical position the powder adds the pressure of its own weight.

2. Iron filings, hanging in the shape of a pencil from a small straight magnet, and supported by a metallic plate or cup. In this case the filaments of filings are already formed by the magnetic forces, and the electric discharge only imparts conductivity to them. A similar form, as I have since learnt, has been successfully used for purposes of measurement.*

3. The most successful form of coherer, having high sensitiveness and sufficient constancy, was made in the following way:—

Inside a glass tube were pasted two strips of platinum foil, A B and C D, along nearly the whole length of the tube (*vide* fig.). One foil is brought out to the external surface from one end of the tube, and the other from the opposite end. The platinum strips are placed with their edges about 2 millimetres apart and have a width of 8 millimetres.

The inner ends of the strips B and C do not extend to the corks which close the tube, so that the powder placed in the latter may not, by penetrating under the cork, form continuous conducting filaments, unaffected by vibration, as has been the case in some forms. The length of the whole tube is from 6 to 8 centimetres, with a diameter of about 1 centimetre. Fig. 1 represents a diametral section of the tube.

The tube, when in use, is placed horizontally, so that the foils are in its lower half and the metallic powder completely covers them. Better results are, however, obtained in this case if the tube is not filled more than half full.

In all the experiments, both the degree and the constancy of the sensitiveness were influenced by the size of the granules of the metallic powder and by the nature of the material. The best results were obtained with iron powder, known in commerce under the name of "ferrum pulveratum"; iron known under the name of "ferrum hydrogenio reductum" offers too great a resistance; coarser grained filings give for a time much greater sensitiveness, but are not constant. Fairly satisfactory results are obtained with copper powder prepared by precipitating powdered copper oxide, heated red hot, in methylated spirits. Metallic filings freshly cut are not suitable, their surface having much too small a resistance. The existence of a thin film of oxide, visible to the eye, is indispensable for a sharp variation of the resistance.

The first and third forms of the instrument were used by me in the experiments, and I think these experiments furnish certain arguments in favour of the views I hold on the nature of the phenomenon.

Desiring to obtain greater uniformity in the formation of the powder, I substituted small shot for the filings; but it appeared to offer too great a resistance, and did not show sensitiveness, even to powerful discharges produced in the immediate neighbourhood of the tube. The surface of the shot had a shiny, black appearance. I cleaned the surface by shaking up the shot in a vessel, the sides of which were covered with glass paper; then the shot, when placed in the tube with the wires, offered a resistance of 10,000 ohms, but under the influences of the discharges the conductivity fell, that is, the resistance of the tube increased to 100,000 ohms. Another kind of shot, the surface of which had the appearance of graphite, gave the better conductivity, and its resistance always varied in the direction of diminution.

The first kind of shot contained antimony, and had a high melting point; the second kind was of almost pure lead.

Having obtained such results with shot, I took for the experimental powder powdered antimony. Like other freshly prepared powders, it possesses very great conductivity, but, becoming oxidised by heating, it acquires peculiar properties in relation to the discharge; its condition was quite unstable; the resistance during discharges sometimes increased, sometimes decreased. It appeared, therefore, that the conductivity acquired by the powder under the influence of electrical vibrations disappeared during the following discharge. Only very energetic discharges in the immediate neighbourhood of the powder gave uniform results; that is to say, a diminution of resistance. These experiments, and also the experiment with platinum films (Branly), and the complete insensibility of powdered carbon to the discharges (Lodge), taken in conjunction with the experiments of Spring on the welding of different metals † at low temperature, point to the idea that in powders under the influence of discharges a union takes place between the particles of the same character, and from a similar cause to that which takes place in Spring's experiments on the welding of metals. Antimony showed itself incapable of welding

* Translation of paper from Russian Physical and Chemical Society's *Journal* for January, 1896.

† O. J. Lodge, the "Work of Hertz."

‡ E. Branly, *Comptes Rendus*, Vol. cxi. and cxii.

§ G. M. Minchin, the *Phil. Mag.*, Vol. xxxvii.

‖ R. Appleyard, *ibid.*, Vol. xxxviii.

¶ *Vide* paper referred to above.

** *Wied. Ann.*, Bd. 55, 599, 1895.

†† O. J. Lodge "On the Sudden Acquisition of Conducting Power by a Series of Discrete Metallic Particles," *Phil. Mag.*, Vol. 37.

* Report in No. 1 of *Zhurn. Russk. Phiziko-Khimich. Obshchestva* 17, 1895.

† W. Spring, *Zeitschrift für Physikalische Chemie*, T. XV., p. 65, 1894.

at temperatures below the melting point; platinum welds with difficulty, and only at very high temperatures; and carbon welds only in the electric arc. At the moment of discharge, the adjacent particles may become heated; that is, they may acquire a considerable increase of kinetic energy, notwithstanding the very small energy of the discharge, since this energy is, momentarily, confined to a very small volume of the substance and, as thermal energy, is slowly dissipated.

To verify the above views, I also made an experiment with oxide of copper; the powder of granular oxide of copper was placed between two silver coins, and compressed for greater conductivity; it proved to be, as anticipated, insensible to the discharge; at least, its resistance did not vary more than 0·5 per cent.; the nature of the variation in my experiments could be clearly observed. I further tried a powder of copper pyrites (sulphides of copper and iron) and a product known in metallurgy by the name of

Fig. 1.

"white stone," which possesses the essential properties of fused sulphide of copper, that is, it is easily fused, but is at the same time brittle, and of crystalline structure. These powders manifested sensitiveness in a tube with the platinum foils. Their resistance decreased, but the amplitude of the variation, other things being equal, was considerably less; their resistance varied by two to three times its value under the action of such discharges as would cause a variation of 10 to 100 times its value in the conductivity of iron filings subject to their influence.

The negative properties of platinised glass and antimony powders seemed to me intelligible from this point of view; weak junctions might be destroyed by a spark, or even by mechanical forces, accompanied by energetic vibrations in the pulverous mass. In all probability the negative properties may be increased by considerable oxidation of the surface even in the copper and iron powders, since under these conditions the formation of continuous metallic filaments will be difficult and further oxidation possible.

The description of these experiments being limited, I omit various attempts to arrange the apparatus with sufficient constancy of sensitiveness with a small number of contacts (small chains, combinations analogous to microphones, &c.).

With such forms of the apparatus, a sensitiveness may be obtained considerably greater than that of the tubes with filings, but I was unable to obtain constancy of sensitiveness. In concluding my remarks on the fundamental effects, I should also mention recent works relating to the subject.

Aschkinass* found that a grating formed of thin tinfoil varied in resistance 2 per cent. under electric vibrations, and it seemed necessary to attribute to the electric vibrations the power to modify the structure of the conductor, at least, in the superficial layer; but Haga† and Mizuno‡ dispute this view, and trace the effects observed by Aschkinass to the discharge path alone, as was the case in the phenomenon examined by us.

Having obtained a satisfactory constancy of sensitiveness by the use of the tube with platinum foils and iron powder, I set before myself another problem, namely, to make such combinations that the union between the filings produced by the electrical vibrations, could be instantly destroyed automatically.

Such an arrangement, indeed, would be advantageous, seeing that it would respond to successive vibrations.

After some attempts to utilise the movement of the frame of a d'Arsonval galvanometer for tapping the tube containing the filings, I succeeded in devising simpler and more effective means. Instead of the galvanometer, I used a telegraph relay and ordinary bell, both for testing the effects of the electric vibrations on the filings and for destroying the conductivity of the latter. With this was combined the apparatus which I am about to describe.

(To be concluded.)

Reduction of Capital.—The Second Division Glasgow Court of Session last week granted a petition by the Mirrlees-Watson Company, Limited, 45, Scotland Street, Glasgow, asking authority to resolutions proposing a reduction of capital. The company was incorporated in July, 1889, with a capital of £500,000, divided into 50,000 shares of £10 each. The Company took over the business of Messrs. Mirrlees, Watson & Co., mechanical engineers, Glasgow, and acquired the patent rights of Homer Taylor Yaryan in connection with evaporation and distillation. The patent right held by the company in the British Yaryan Company, Limited, have not proved of the value that was anticipated, and stood in the balance-sheet much above their value. The reduction of capital is to £125,000, and is effected by cancelling £375,000 of the existing capital.

* E. Aschkinass, *Verh. Phys. Gesellsch zu Berlin*, Jahr. 13, No. 4.

† H. Haga, *Wied. Ann.*, Band., 56, 571, 1895.

‡ T. Mizuno, *Phil. Mag.*, V. 40, 497, 1895.

PHYSICAL SOCIETY.

Ordinary Meeting held November 9th.

Prof. A. W. Reinold, F.R.S., Vice-President, in the Chair.

Dr. R. A. Lehfeldt read a paper on "Electromotive Force and Osmotic Pressure."

This paper is an attempt to explain the difficulty in the interpretation of the ordinary logarithmic formula for the E.M.F. between a metal and solution, pointed out by the author at the Dover meeting of the British Association. An expression for the E.M.F. of a concentration cell is obtained thermo-dynamically upon the assumption that the electrolyte is only partially dissociated. A partition is used which is permeable to water but not to the salt or its ions, and the conclusion follows that the E.M.F. depends not on the osmotic pressure of the metallic ions, but on that of the solution as a whole. A graphical representation is given plotting osmotic pressure against dilution, assuming Boyle's law to hold, and it is shown that the E.M.F. is not proportional to the integral $\int p\,dv$, but to the converse integral $\int v\,dp$. Assuming, further, that the osmotic pressure changes according to Van der Naals's equation, the E.M.F. is greater than that calculated from Boyle's law. If the electrolytic solution pressure is calculated from the integral $\int p.\,dv$, it comes out 10^{19} atmospheres; but if from the converse integral, the value obtained is about 20,000 atmospheres. A comparison between actual E.M.Fs. and those derived from the equation given by the author should afford, if the formula is correctly deduced from the assumptions made, a measure of how far the osmotic pressure deviates from that indicated by Boyle's law. Experiments upon concentration cells have been made by Helmholtz, Wright and Thomson, Moser, Lussana, and Goodwin, but as their work was performed upon cells with migration of ions, the calculation of the osmotic pressure is rendered uncertain by the introduction of the transference ratio. Accordingly the author has measured the E.M.Fs. of cells without migration, using zinc as electrodes, and chloride and sulphate of zinc as salts. The E.M.F. was measured by the compensation method, using a Post Office box, through which a current was sent by an accumulator. The accumulator kept up a constant potential difference, and was standardised daily by means of a Clark cell. The experimental results agree with the calculated over the range centi- to deci-normal, showing that the deviation from the value given by the logarithmic formula is accounted for by the incomplete dissociation of the salts. The osmotic pressures are then calculated from the E.M.Fs., and the values of $p\,v$ plotted. They show irregularities due to the combined effect of the decreasing dissociation of the salt and the increasing departure from Boyle's law. Dividing the product $p\,v$ by van't Hoff's factor, determined from conductivity, values are obtained showing variations similar to those observed in the behaviour of gases when subjected to high pressure.

Mr. Whetham said there was one form of membrane which is quite permeable to water and yet does not allow either salts or the ions to get through. He referred to the free surface of the solution itself. The water being volatile can get out, but the salt cannot.

Dr. Donnan said the author seemed to have discovered things well known; for instance, the integral $\int v\,dp$ is generally taken as proportional to E.M.F. He expressed his interest in the explanation of the difficulty in the logarithmic formula.

Dr. Lehfeldt, in reply, said Goodwin had used the integral $\int v\,dp$, but had not made any numerical calculations by means of it.

Mr. A. Campbell then read the following papers:—

(a) "On a Phase-Turning Apparatus for Use with Electrostatic Voltmeters."

Electrostatic voltmeters are particularly insensitive at the lower parts of their ranges, the divisions closing in very much towards the zero point. When measurements of small direct-current potential differences have to be made it is an easy matter to add to the voltage to be measured a constant voltage large enough to bring the deflection to an open part of the scale. If the small voltage to be measured is an alternating one, it is necessary that the auxiliary voltage should alternate with the same frequency and be in phase with it. The apparatus described enables the phase of the auxiliary voltage to be turned until it agrees with the one to be measured. The phase difference referred to is not the time lag, but the angle whose cosine is the power factor, and may be called the power lag. The method is to get two independent equal voltages, v_1 and v_2, differing in power phase by $\frac{\pi}{2}$, and to add together suitable fractions of these, such as $v_1 \sin\phi$, $v_2 \cos\phi$. The resultant is equal to v_1, but with the power phase turned through ϕ. The unknown small voltage is connected in series with an auxiliary voltage and a voltmeter, and the phase of the latter voltage is turned until the maximum deflection is obtained.

(b) "On a Method of Measuring Power in Alternating Current Circuits."

The circuit on which the power is to be measured is connected in series across the supply circuit with a small non-inductive resistance. By means of a transformer the small voltage on this resistance may be transformed into one whose power phase is π behind the voltage on the resistance. This is added to the voltage on the circuit to be measured, and then reversed and added again. The difference of the squares of these effective resultants is shown to be equal to a constant into the power to be measured. If there is any direct current it must be measured separately by a Weston voltmeter or other suitable instrument.

(c) "NOTE ON OBTAINING ALTERNATING CURRENTS AND VOLTAGES IN THE SAME PHASE FOR FICTITIOUS LOADS."

When testing instruments for the measurement of large amounts of electrical power or energy, it is usually desirable to do so by means of fictitious loads, *i.e.*, by applying to the instrument under test current and potential difference representing the required load. In order to obtain a fictitious non-inductive load with alternating currents, the potential difference and current should be in the same phase. The current for the instrument under test is got by means of a transformer worked on a 100-volt circuit. The potential difference in the same phase is got by allowing the current to flow through a non-inductive resistance, and increasing the voltage at the ends of the resistance to the required amount by means of another transformer.

The Society then adjourned until November 23rd.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

No. 32.

"WOODSTOCK" writes* :—"Thanking you for your kindness in answering my query last week and also for stating what you require. In answer to (*a*) there is no person nor authority supplying electricity in any form in the parish and only the private installation in the area; (*b*) There is the rural district council, but the parish council are the lighting authorities, but for only part of the parish, the part which they require to light, the other is not rated. It is only a small town, and would only be a small installation. Could you also state how and where we should have to get the order?"

* Seeing that the parish in question is in the district of a rural district council, it appears to be a rural parish within the Local Government Act, 1894 (56 & 57 V., c. 73, Section 1). The rights and powers of a parish council are defined by that Act. The combined effect of Sub-sections (1) and (7) of Section 7 of the Local Government Act is that the parish council may adopt the Lighting and Watching Act, 1833, which provides that the lighting of the parish may be effected by gas, oil, *or otherwise*. The "otherwise" appears to include electric light, and I therefore assume that the parish council in question are armed with the necessary powers.

The following steps must be taken by a local authority desirous of obtaining a provisional order for the supply of electricity within their own area:—

1. A resolution must be passed at a special meeting held after one month's notice. The notice must be given in the manner in which notices of meetings of such local authority are usually given. [Electric Lighting Act, 1882, Section 3, Sub-section 6.]

2. On or before *July 1st* notices must be given by promoters to the local authority of any district proposed to be supplied. Thus, in the case now before us, notice must be given to the rural district council if, as we understand, the electric light is to be supplied in any part of their district. [E.L.A., 1882, Section 4 (1).]

3. During October and November notices must be published by advertisement describing the application for and the objects of the provisional order. A copy of the advertisement, together with map of district, must be deposited on or before November 30th with the Board of Trade and the clerk of the peace, &c. The contents of this notice are described in Rule XIII. of the Board of Trade regulations issued in September, 1899 [hereinafter referred to as "B.T.R."].

4. There must also be deposited in the Private Bill Office, and with the Clerk of the Parliaments, duplicates of plans, &c. [Standing Order 39 of the House of Lords, and Standing Order 39 of the House of Commons.]

5. On or before December 21st a memorial for the provisional order must be lodged with the Board of Trade together with a draft of the order. [See R. xiii. B.T.R.]

6. A provisional order shall not be granted by the Board of Trade until after the expiration of a period of three months from the date of the first publication of the public advertisement, nor until opportunity has been given to all parties interested to make representations or objections to the Board of Trade with reference to the application.

7. On January 16th Parliamentary agents or solicitors must be prepared to prove compliance with the Electric Lighting Acts and the Board of Trade rules by this date; and the proofs must be completed on or before February 22nd. [Rule xvii.]

The foregoing outline of procedure may prove useful to our correspondent, but we would recommend him to procure a copy of the rules (which can be obtained for a few pence from Messrs. Eyre & Spottiswoode) before taking any decisive step. It is worthy of remark that he will apparently be unable to procure an order *this* year; but it should be pointed out that there is no provision in any of the Electric Lighting Acts to prohibit any body or person from supplying electricity independently of Parliamentary authority. We might add that we do not understand the clerk's advice where he said that urban powers were necessary.

* "Woodstock's" query in last issue was:—"The parish council are desirous of lighting the town by electricity. How can the present authorities obtain the power? Only part of the parish is in the lighting area. The clerk says we are to get urban powers. Is this so? The gas is a monopoly, and is very unsatisfactory."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,782. "Improvements in metal or composition sheathed insulated electricity conductors." D. ROBERTS. Dated November 5th.

19,822. "An improved conduit for electric cables and the like." O. C. SUMMERS. Dated November 5th.

19,824. "Improvements in and relating to printing by telegraphy." J. BURRY. Dated November 5th. (Complete.)

19,829. "An improvement in electrical locking apparatus for railway signals." G. H. JELFS. Dated November 5th.

19,836. "Improvements relating to electric call apparatus." M. J. BUXBAUM. Dated November 5th.

19,847. "Improvements in electric fuses." O. L. PRAED. Dated November 5th.

19,852. "Improvements relating to electric lamps." W. FELSCH. Dated November 5th.

19,858. "Improvements in electrical switches." W. SUMNER. Dated November 5th.

19,877. "Improvements in printing-telegraph machines." A. L. SHEPARD. Dated November 6th.

19,900. "Improvements in and connected with electric punka-motors." H. SPUHL. Dated November 6th. (Complete).

19,902. "Improvements in joint-boxes for distribution of electric current from concentric or other cables." F. E. HAMMOND. Dated November 6th.

19,910. "Improvements in or relating to overhead trolley wires or conductors for electric traction, overhead electric cables, or the like." A. W. HANCOCK, J. LEIGHTON, and R. HACKING. Dated November 6th.

19,922. "Improvements in overhead electric fittings." P. T. J. BUTLER and F. KLEINSTEUBER. Dated November 6th.

19,934. "Improvements relating to the mounting of electric bells." C. WOITTEQUAND. Dated November 6th. (Complete.)

19,945. "Improvements in incandescent electric lamps." W. P. THOMPSON. (A. Sinding-Larsen, Norway.) Dated November 6th. (Complete.)

19,948. "Improvements in and relating to automatic switch-systems for telephone lines." J. P. PETERSON. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 10th, 1900, being date of application in Sweden.) Dated November 6th.

19,951. "Improvements in or relating to dry core cables, and the like electric conductors." G. E. HEYL-DIA. Dated November 6th.

19,987. "An improved electrical connection or bond for application to railway or tramway rails." W. R. STEES, A. H. JOHNSON, and C. J. COOKE. Dated November 7th.

19,988. "An improved insulating rail joint for railways or tramways which offers considerable resistance to currents of electricity." W. R. STEES, A. H. JOHNSON, and C. J. COOKE. Dated November 7th.

19,989. "Telephone transmitter of the sounds of rifle fire, maxim fire, pom-pom fire, and Long Tom fire, with the noise of its shell in progress, and its ultimate bursting." A. J. C. JACKSON. Dated November 7th.

20,016. "Improvements in and connected with switches or keys in electric lampholders." H. OPPENHEIMER. (Actien Gesellschaft Mix & Genest, Germany.) Dated November 7th.

20,044. "Improvements relating to the manufacture of insulating material." C. F. NAFZGER. Dated November 7th.

20,049. "Improvements in the manufacture of elements or plates for electrical storage batteries." J. M. RICHARDSON and H. RAMSBOTTOM. Dated November 7th.

20,110. "A safety swinging arm for carrying overhead electric wires." H. G. THOMAS. Dated November 8th.

20,112. "Induction electric telephony and telegraphy." J. R. QUAIN. Dated November 8th.

20,135. "Improvements in the control of electrically-propelled vehicles or trains." E. H. TYLER and A. G. HANSARD. Dated November 8th.

20,146. "A sound strengthening appliance for telephone stations." F. OPRENDEK and L. RODER. Dated November 8th.

20,152. "Improvements in or relating to magneto-electric and other ignition devices." J. RIDLEY and G. GIBSON. Dated November 9th.

20,177. "Commutator or collector for electrical purposes." E. BATAULT. Dated November 9th.

20,179. "Improved construction of electric arc lamp." E. R. SMITH, J. J. RATHBONE, and C. B. KING, JUN. Dated November 9th.

20,186. "An improvement in air brakes controlled electrically, and by air pressure." C. D. ABEL. (Siemens & Halske Aktien-Gesellschaft, Germany.) Dated November 9th. (Complete.)

20,197. "Improvements in the construction of metal troughs for laying electric mains." M. LACHMAN. Dated November 9th.

20,200. "Improvements in or relating to electrolytic cells." J. H. NOBLE and A. MERRY. Dated November 9th.

20,201. "Improvements in or connected with apparatus for covering electric conductors with insulation." G. E. HEYL-DIA. Dated November 9th.

20,214. "Electric lighting cane." T. BERGMANN. Dated November 9th. (Complete.)

20,231. "Improvements in electrical connections." R. F. HALL. Dated November 10th.

20,255. "A new or improved fitting or accessory for electric ceiling roses and the like." W. G. STONES. Dated November 10th.

20,256. "Improvements in or relating to swinging brackets for electric lights and the like." A. J. BOULT. (K. M. Beifert & Co., Germany.) Dated November 10th.

20,264. "Improvements in connections for electric mains." C. D. BURNET. Dated November 10th.

20,277. "Improved means for supporting the osmium filaments of electric incandescent lamps." O. IMRAY. (The Oesterreichische Gasglühlicht und Electricitäts Gesellschaft, Germany.) Dated November 10th.

20,285. "Improvements in chains for suspending electroliers, electric lamps and the like." E. FLETCHER. Dated November 10th.

‡ T. Mizuno, *Phil. Mag.*, V. 40, 497, 1895.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1898.

18,366. "Improvements relating to the regulation of electromotive force." N. Rows. Dated August 26th, 1898. (Date claimed under International Convention, January 27th, 1898.) Relates to the regulation of electromotive force, particularly that supplied by a stationary transformer, the primary being supplied with alternating currents. A switch for cutting out sections of the primary is combined with an inductive regulator arranged to prevent sudden changes in the electromotive force. The switch base had two circular contacts, and segmental contacts connected to the segments of the transformer. The regulator has its fixed coils connected across the working circuit, and its coils are supplied at intervals from the mains through a switch. The regulator makes one revolution for each quarter revolution of the switch, and for one half of a revolution the coils are short-circuited. 2 claims.

18,567. "Improvements relating to motor-trucks for electric and other railways." G. J. Capewell. Dated August 30th 1898. The axle-truck has a pair of central traction wheels running upon the single rail, each wheel having a motor arranged on each side of it and concentric with its axle. A third axle carries small wheels which run between retaining-rails. The truck frame consists of two vertical side plates which are brought together at the ends to reduce atmospheric resistance, and two vertical central plates which form recesses for the traction wheels, and are joined together by plates and are connected to the side plates by plates. The frame is closed at the top by plates and at the bottom by covers which are hinged. The plates have bottom plates carrying springs for supporting the platform plate. 4 claims.

18,583. "Improvements in systems for converting the energy of alternating electric currents into mechanical energy by means of induction motors." R. Belfield. (B. G. Lamme.) Dated August 30th, 1898. An alternating current induction motor is provided with means for securing a variable speed with a large starting torque, for obtaining a constant speed with less than the rated load, and for operating the motor at different speeds without any substantial variation in torque. The invention is particularly useful in connection with motors employed for crane or elevator work. The primary member of the motor is supplied with a variable electromotive force by means of transformers, the secondaries of which are divided up, and provided with switches for varying the number of sections in circuit. In one form the switches are intended to be actuated by hand, but they may be actuated automatically, as the load of the motor varies, by means of solenoids in the primary circuits of the motor. For securing constant torque with variable speed, choking coils are inserted in the primary circuits of the motor. 3 claims.

18,584. "Improvements in controllers for electric motors." H. P. Davis. Dated August 30th, 1898. (Date under International Convention, April 25th, 1898.) Relates to apparatus for controlling the power and speed of electric motors, particularly railway motors of large capacity. The switch for varying the resistance in circuit with the motors is separated from the switch for varying the connections of the motors, and the two switches are connected by gearing so that the operation of the resistance varying switch will, at the proper time, cause the second switch to alter the connections of the motors from series to parallel and *vice versa*. In order to reduce sparking, the resistance is divided into a number of sections, and a portion of each section is cut in or out simultaneously as the operating handle is revolved. Reversing and cut-out switches are also provided, and these are connected by interlocking devices with the switch for varying the connections. In the form of apparatus employed for controlling a pair of motors the operating shaft carries by means of radial arms four contact brushes which move over sets of resistance contacts. A step-by-step movement is ensured by a lever pivotted to one of the arms and engaging with notches in a fixed ring. The shaft, by means of segmental bevel-gearing, operates a shaft at right angles to it, and the latter is geared to the spindle of the contact from which varies the connections of the motor. The reversing switch is actuated through segmental gearing from a shaft and is connected with the central switch by interlocking gear, which prevents movement of the latter during reversal. The switch for cutting out one or other of the two motors is similarly actuated from a shaft and also interlocks with the switch. After the motors have been changed from series to parallel, their field-magnets are shunted through resistances by a further rapid movement of the switch communicated to it from the shaft by additional bevel gearing. A modification of the controller for use with four motors is also described. In this form a combined cut-out and reversing switch is employed on each side of the switch which varies the motor connections. 4 claims.

18,613. "Improvements in telephonic systems and apparatus." J. E. Kingsbury. (The Western Electric Company.) Dated August 30th, 1898. Relates to improvements in telephone systems such as described in Specification No. 8,222, A.D. 1895. At the subscriber's station a high resistance microphone having about one-third the usual amount of carbon granules may be employed, an ordinary receiver being connected in a loop circuit with a condenser. The bell may be arranged at a shunt across the receiver or in earthed circuits forms a shunt to earth. The arrangement of the lever contacts and the induction coil circuits are varied to suit the different circumstances. The current is supplied from a central station generator arranged across the loop and having impedance coils on either side connecting it to the loop. When a dynamo charging secondary cell is employed, the interruptions of the current are deadened either by the insertion of impedance coils in the generator mains, or by making the armature with a large number of sectors, so that the interruptions would form a very high note. 22 claims.

18,630. "Improvements in couplings for connecting together the electric wires as used on railway trains for electrical communication and such like." A. Shiels. Dated August 31st, 1898. Couplings for use on railway vehicles. Each half-coupling consists of a coating having a corrugated extension, and within an insulating base carrying a contact spring or springs. A tubular extension is fitted on the base, and a rubber or like ring to serve as a cushion. One wire is connected through the spring contact, and the other through the metal part of the coupling. The appliance is an improvement upon the coupling described in Specification No. 8,743, A.D. 1892. 1 claim.

23,497. "Improvements in electric tramways on a road contact system." W. H. Merriman. Dated November 8th, 1898. Electric railways and tramways on a road contact system with mechanically-operated switches. Treadles or a continuous flexible strip lying in the grooves of the ordinary or additional rails are depressed by the wheel flanges and act through studs, counterweighted levers, collars, and springs to raise the contact studs. In the raised position, a collar on the stud completes the circuit at the spring contact from the feeder. The lower part of the stud may act as a dash-pot in the socket, and the stud is surrounded by insulating material. 3 claims.

23,503. "Improvements in devices for controlling the operation of electric motors." H. H. Lake. (H. Sos.) Dated November 8th, 1898. Switches for controlling the duration and direction of the motion of electric motors for various purposes, such as steering and manœuvring ships, the training of guns from a distance, turning the turrets on ships, railway and other signals, elevators or hoists. The contacts are too complicated for abridgment without reference to a drawing. 4 claims.

23,510. "Improvements in insulators for incandescence electric lamps." H. H. Lake. (A. H. Spencer.) Dated November 8th, 1898. Relates to incandescent lamps. A holder having a casing and a metal socket to carry and connect a screw-capped lamp, is provided with a hard rubber or other insulating sleeve, screwed on the socket. The sleeve covers the exposed parts of the socket, and the cap of the lamp, and it is provided with a shoulder to hold a reflector against the casing. A washer may be interposed between the shoulder and the reflector, or between the shoulder and the casing when no reflector is used. The sleeve may have its ends alike, so that either may be inserted in the holder, or the outer end may be enlarged. The use of the holder as a wall socket is mentioned. 3 claims.

23,529. "Improvements in a method and system for generating and distributing electric energy." The British Thomson-Houston Company, Limited. (C. M. Green.) Dated November 8th, 1898. A dynamo-electric generator is constructed with two or more independent armature windings which are connected in series with the load; this is divided into a corresponding number of parts, each part being interposed between two windings. The field winding of the generator is also included in the series, and switches are provided for short-circuiting it or parts of the load. Each part may be a series of arc lamps; the highest normal difference of potential between any two parts of the whole armature is that due to any one winding. The invention is applicable to open coil armatures, and the current produced may be automatically kept constant by a solenoid shifting the brushes round the commutators so as to take it at the difference of potential required by the load. 10 claims.

23,530. "Improvements in a method and apparatus for generating and distributing electric energy." The British Thomson-Houston Company, Limited. (C. M. Green.) Dated November 8th, 1898. A multipolar generator is provided with a closed coil armature, the windings of which are divided into sections connected to separate commutators and corresponding to pairs of field magnet poles. The arrangement is shown diagrammatically, the windings are in two sections, separated on a diameter by additional insulation, and opposite pairs of commutator segments are connected together. The sections are connected in series with the load, which is divided into a corresponding number of parts, each connected between two sections of the armature. The field winding is also included in the series, and switches are provided for short-circuiting it or parts of the load. The current generated may be kept constant by an ordinary automatic regulator shifting the brushes round the commutators. 4 claims.

23,531. "Improvements in a method and apparatus for generating and distributing electric energy." The British Thomson-Houston Company, Limited. (C. M. Green.) Dated November 8th, 1898. A generator is provided with two or more armatures carried on one shaft by magnetic fields common to them, and connected by independent commutators and brushes in series with the load, which is divided into a corresponding number of parts, each connected between two armatures. The field winding is also included in the series, and switches are provided for short-circuiting it or parts of the load. The currents generated may be kept constant by an ordinary automatic regulator shifting the brushes. 7 claims.

23,532. "Improvements in electric brakes for electric railway cars and other electrically-operated mechanisms." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated November 8th, 1898. Relates to electric brakes which are especially adapted for electrically-propelled railway vehicles, as the brake shoe is applied to the outside of the wheel, leaving the space between the wheels free for the motors. A ring is attached to the wheel, or the web of the wheel is faced for the break shoe to bear upon. The shoe is formed as a closed ring with the winding placed in an eccentric groove, and it is provided with lugs which engage lugs on the frame in which the journal box is mounted. An L-shaped bar secured to the journal box supports the brake shoe, and a ring attached to the wheel engages a flange on the shoe to limit the size of the air gap. The bars of the truck frame rest on the journal box as usual. 10 claims.

23,533. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (C. E. Harthan.) Dated November 8th, 1898. A frame of an enclosed arc lamp, is attached to a flanged metal bell which is hung by an insulated eye-bolt and a loop from a hook on a ceiling plate or other support, provided with terminals. The frame carries side tubes and a connecting plate. The plate is insulated by providing holes in its ends with mica or other bushings, within which metal bushings are secured by expanding them over washers; the bushings are placed on the side tubes, and secured by hollow screws. The upper part of the lamp is surrounded by an ornamental casing, consisting of a corrugated cylinder, two cornices, and an upper part surrounding the supports and the ceiling plate. The cornices are made alike, by spinning each in two parts which overlap. The upper casing is in two parts hinged together at one side to permit removal; they overlap the upper cornice and above this are contracted and contain a metal cup which surrounds the bolt and prevents heating of the ceiling plate, &c. Air passes through the lower cornice and holes into the cylinder, and escapes between the upper cornice and upper casing. A switch projects through the upper casing. A resistance consisting of helically-coiled wire, is placed in notches in porcelain strips, which are secured on asbestos packing, in grooves in the bell by lugs on the bell and a metal ring. The upper turns of the resistance form a loop which may be more or less short-circuited by a movable clip. The lower end of the resistance may be connected to any of the several loops on the solenoid, to adapt the lamp for different currents. The regulating tube fastens into the bell where it is connected with two dash-pots, and at its lower end it carries an open frame giving access to the upper carbon. The clutch operates by contact with a plate which is supported in a definite position by perforated lugs resting loosely on projections on rods. The plate is slotted to receive the middle of the clutch. It is formed with a bent lug and a hook at the opposite side, to support the cap for the arc-enclosing globe, so that if, in trimming, the cap is disengaged from the globe and lug, it still hangs from the hook. The outer globe rests on a cup carried by a nut on a screw, which is supported by a bar and rods within the side tubes. These rods are normally held up by hooks on a pivoted yoke; the hooks are formed so that before they can be disengaged to lower the globe it is necessary to unscrew the nut and raise the bar and rods. 27 claims.

27,599. "Improvements in electro-hydraulic brakes for railway vehicles and other purposes." C. Darey. Dated December 31st, 1898. Relates to improvements in the electro-hydraulic brakes described in Specification No. 27,122, A.D. 1896. The accumulator is automatically recharged after the brakes have been applied. The pump is actuated by a bell crank, the arm of which is looped at the end and carries a roller or disc held in a central position by springs. This roller or disc engages with a spiral cam on an axle of the vehicle. When the accumulator is full a stop actuated by the piston rod engages a finger on the bell crank and holds it out of engagement with the cam. At the same time the cup leather uncovers a passage so that the reservoir and accumulator communicate. In a modified arrangement the pump is continuously operated by an eccentric, and the charging of the accumulator is stopped by lifting the suction valve of the pump. This is effected by the piston depressing a lever within the reservoir which rocks a second lever acting on the valve. The plunger of the brake cylinder is made in two parts, united by a spring so that the part can move independently of the other, which is connected to the rigging. The forward end of the cylinder communicates through a passage with a pipe leading to the reservoir, while the rear end communicates by a passage with the casing of a tap, which normally places the passage in communication with a pipe leading to the accumulator. By rotating the tap the end can be put in communication with the reservoir to render the brake inoperative. The supply of fluid from the accumulator to the brake cylinder is controlled by a valve held on its seat by an electro-magnet. When the current through this magnet is stopped the brakes are applied. To release the brakes the valve is opened by exciting the magnet so that the contents of the chamber flow back through the pipe to the reservoir. The brakes are manipulated by a switch on the engine, but are applied automatically in event of the breakage of a coupling or damage to the brake itself. Wear of the brake blocks is compensated for by a ring made in halves clasped on the plunger by a spring. The ring allows the plunger under the brake pressure to move outwards through it to take up the wear of the blocks, but prevents its return. 5 claims.

27,613. "Improvements in electric fuse holders." C. Howard. Dated December 31st, 1898. The fuse wire, which is led in through perforations, is fitted in a dished plate or cup filled in with cement or the like and covered with a glass, mica, or like transparent cover which may be luted on by cement. The cup is secured to the base which is fitted with terminal contacts by a screw and a nut. 5 claims.

27,641. "Improvements in detachable and swivelling electric light fittings." J. F. Wakelin and C. J. Weston. Dated December 31st, 1898. A metal case is screwed to the bracket, and contains an insulator supporting two or more sockets connected with the supply wires and switches. Holders for the lamps, and shade, or reflector are attached to a metal case, which is secured to the fixed part by a coupling ring either screw-threaded or with a bayonet-joint. The case contains an insulator supporting pins, which are connected to the lampholders, and fits the sockets. The shade holder may be detachable. A hinge may be interposed between the case and lampholders, to allow the lamps to be turned through a small angle; the provisional specification mentions the use of clamping-nuts on the hinge. 2 claims.